Accessible Safeguards Tools for Everyone

Safeguards are an important regulatory component of nuclear facilities that ensures material is present and accounted for. Designing effective safeguards systems helps reduce costs to ensure nuclear facilities can remain cost competitive. Modeling and simulation play an important role during the design stage as testing on real facilities is often costly or infeasible.

Historically, safeguards have been difficult to approach owing to a lack of easily accessible tools and dense statistical literature. Sandia National Laboratories has several decades of experience developing modeling and simulation tools that support safeguards research and development. This next generation toolset that includes MAPIT, F3M, and SSPM-L is designed to have robust, transparent documentation while maximizing the amount of open-source code. Together these codes enable end-to-end systems-level safeguards analyses for bulk nuclear facilities.

Team Overview

The Fuel Cycle and Safeguards group at Sandia National Laboratories that develops and maintains these safeguards tools is comprised of a diverse group of experts with collective decades of experience. The group specializes in several areas:

- Modeling and Simulation
- Digital Twins
- Applied Data Science and Machine Learning
- Statistical Routines for Safeguards

Scan the QR code to learn more.

MPACT Program

This work is sponsored by the United States Department of Energy's Office of Nuclear Energy Materials Protection Accounting and Control Technologies. This toolset is part of a larger DOE-NE effort to support civil use of nuclear energy in the United States through the MPACT program.

MPACT
Materials Protection Accounting and Control Technologies

Scan the QR code to learn more.

U.S. DEPARTMENT of ENERGY | NNSA National Nuclear Security Administration | Sandia National Laboratories

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Integrated Safeguards by Design

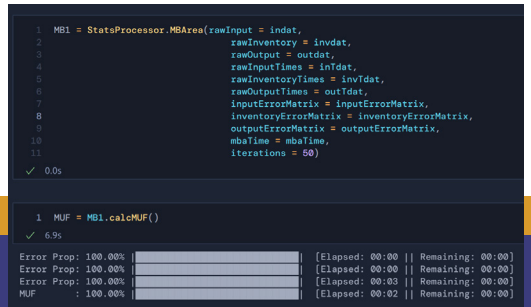
MODELING AND SIMULATION TOOLS

Material Accountancy Performance Indicator Toolkit

SIMPLIFYING ACCOUNTANCY FOR BULK FACILITIES

Material accountancy is a cornerstone of safeguards and security for nuclear fuel cycle facilities. However, the underlying methodologies can often be difficult to interpret and implement. Written in Python, the Material Accountancy Performance Indicator Toolkit (MAPIT) is the first free and open-source toolkit for performing material accountancy for bulk nuclear facilities.

- **Implements common statistical tests**
- **Automated error propagation**
- **Comprehensive documentation**
- **Rich API and intuitive GUI**



```
MB1 = StatsProcessor.MBArea(rawInput = indat,
                            rawInventory = invdat,
                            rawOutput = outdat,
                            rawInputTimes = inTdat,
                            rawInventoryTimes = invTdat,
                            rawOutputTimes = outTdat,
                            inputErrorMatrix = inputErrorMatrix,
                            inventoryErrorMatrix = inventoryErrorMatrix,
                            outputErrorMatrix = outputErrorMatrix,
                            mbaTime = mbaTime,
                            iterations = 50)
```

0.0s

```
MUF = MB1.calcMUF()
```

6.9s

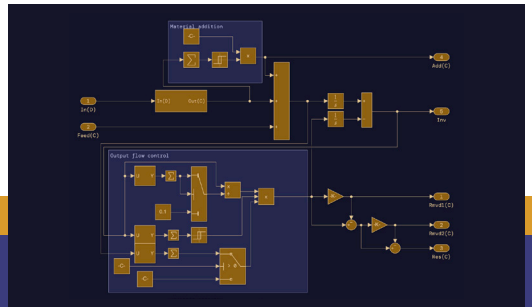
```
Error Prop: 100.00% |                    | [Elapsed: 00:00 || Remaining: 00:00]
Error Prop: 100.00% |                    | [Elapsed: 00:00 || Remaining: 00:00]
Error Prop: 100.00% |                    | [Elapsed: 00:03 || Remaining: 00:00]
MUF       : 100.00% |                    | [Elapsed: 00:02 || Remaining: 00:00]
```

Fissile Facility Flow Modeler

PLUG AND PLAY NUCLEAR FACILITY MODULES

Modeling bulk nuclear facilities during the design phase is important to develop effective and cost-effective safeguards systems that meet regulatory requirements. The Fissile Facility Flow Modeler (F3M) is an open-source series of modules built in MATLAB Simulink that can be used to represent operations and model flows of a bulk nuclear facilities.

- **Computationally efficient**
- **Easy-to-use GUI**
- **Readily integrated with MAPIT**



Separation and Safeguards Performance Model Library

COMPLETE SIMULATION OF NUCLEAR MATERIAL FLOWS

Developing realistic datasets is an important component to system level safeguard design. The Separation and Safeguards Performance Model Library (SSPM-L) is a collection of representative nuclear facility models based on the Fissile Facility Flow Modeler (F3M). The library contains models for aqueous reprocessing and fuel fabrication with pyroprocessing and enrichment currently in development.

- **Simulates flow of materials**
- **Multiple model types available**
- **Readily integrated with MAPIT**