MPACT
Materials Protection Accounting and Control Technologies

U.S. DEPARTMENT of ENERGY | Office of Nuclear Energy

FY2025 QUARTER 4 NEWSLETTER

Materials Protection Accounting and Control Technologies (MPACT) Quarterly Newsletter

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Program Manager Note

Is anyone else depressed at how quickly this summer has come and gone?

It may not feel like it temperature-wise for my fellow Washington area denizens, but we are fully focused on October and beyond (new fiscal year anyone?)! Here is what we are thinking about:

MPACT has been a technology research and development program since its inception. We are very proud of our researchers, the work they do, and the technologies and techniques they produce. Over the past few years, we have increased efforts to get these tools into safeguards practitioners' hands. We are doing this through outreach programs like this newsletter and our website; our safeguards education activities, including the Material Control and Accounting (MC&A) Statistics for Nuclear Regulatory Commission Requirements online refresher course that occurred Aug. 19 and 21; and our engagement with U.S. industry. For FY-26, we are striving to maintain a balance of all these activities while continuing our strong research and development tradition.

We are also focused on doing our part to support the administration's vision for nuclear energy. Our FY-26 plans will reflect U.S. efforts as global leaders in nuclear energy. We will do this by developing MC&A tools for advanced reactor fuel fabrication facilities and working with U.S. industry on how to develop MC&A plans for the facilities they are developing. We will also support the development of future safeguards practitioners – just one part of the U.S. nuclear workforce needed to staff future nuclear facilities. It is exciting to be in the nuclear field right now, and we are going to help push!

Finally, we are thinking about sustainability, efficient use of our nuclear resources and the future. We are thinking about how we can support advanced reactor spent fuel management. We are working closely with other Department of Energy Office of Nuclear Energy programs to identify potential MC&A challenges for advanced nuclear fuel cycles. Based on the advanced reactor concepts under development today, the potential number of future U.S. fuel cycle scenarios is staggering. In FY-26 we will start working through potential MC&A items identified in this year's Comprehensive Fuel Cycle Nuclear Materials and Accounting Controls Initiative – an effort to identify and prioritize MC&A challenges as the U.S. fuel cycle evolves. These are exciting times, indeed.

Thanks for reading our quarterly newsletter! Please don't hesitate to drop us a note and say hi.

Tansel Selekler

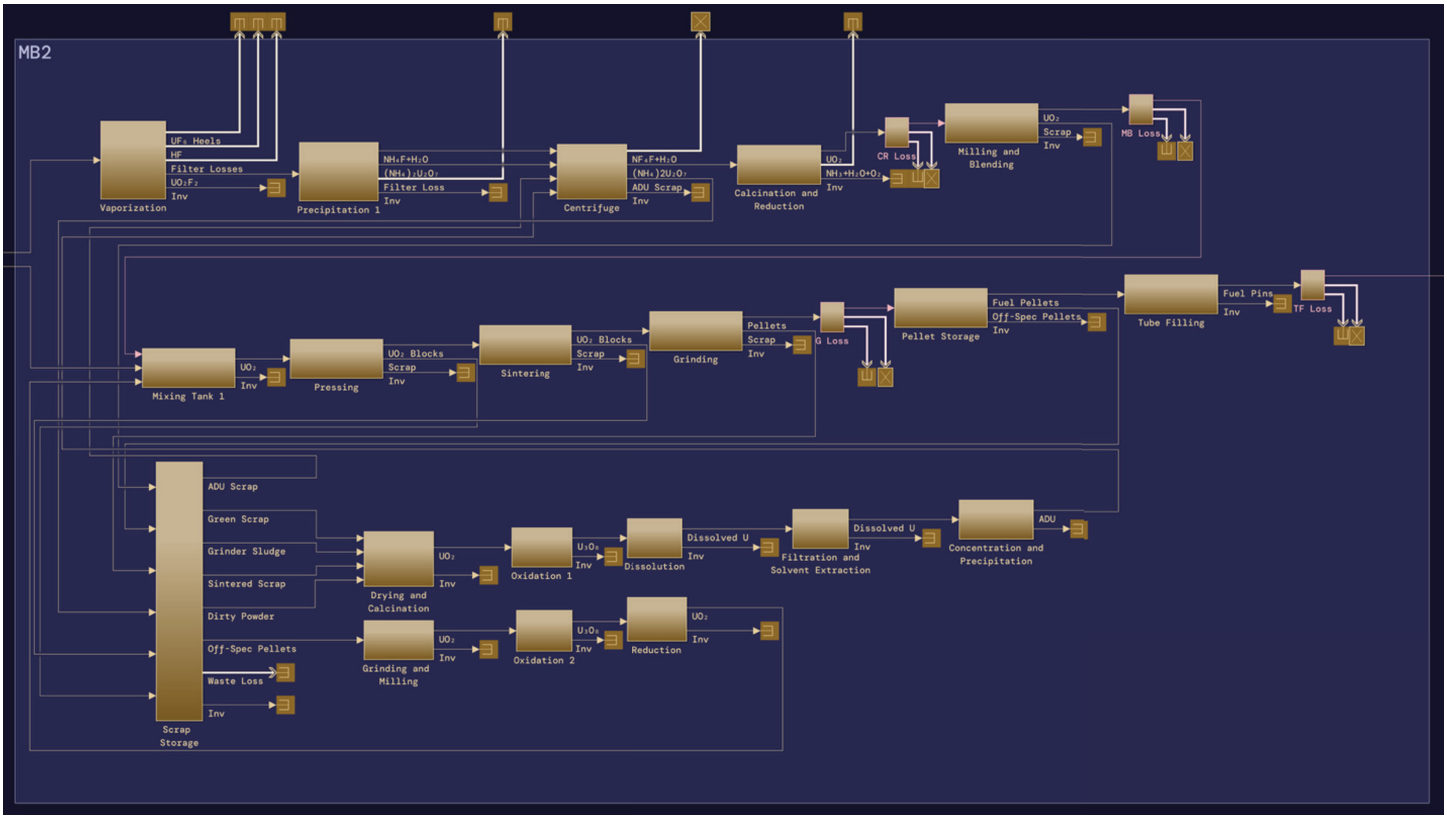
MPACT FEDERAL PROGRAM MANAGER

MPACT Technical Update Highlight – *Open-Source Modeling and Simulation for Nuclear Nonproliferation*

Material accountancy is an important requirement for licensing any nuclear facility. The underlying methods to perform such can become complex and challenging to understand, particularly for those new to material accountancy. Further, facility retrofits during construction to meet regulatory requirements can be expensive, so considering material accountancy during the facility design phase is key. MPACT supports the development of several transparent, straightforward open-source tools to streamline the design of accountancy systems. These tools can help answer the what-if questions early in the design phase, thereby optimizing cost and system performance.

The entire suite of tools – MAPIT, F3M, and SSPM-L – have seen significant improvements in fiscal year 2025. MAPIT has added support for accountancy of discrete items. Modeling with discrete items can improve process-model run times by as much as eight times. MAPIT also saw improvements to error handling with the inclusion of zero-error specification and the possibility to recalibrate sensors.

The F3M library of modules launched on GitHub this year with an initial offering of modules that could be used to create fuel fabrication or aqueous modeling blocks. The research team added complete documentation for all 30 initial blocks. SSPM-L is our library of completed models based on F3M. The team added models of a generic Tri-structural ISOtropic fuel, generic low enriched uranium fuel fabrication and generic EChem facilities this year. SSPM-L holds reference models of generic fuel cycle facilities that can be quickly run to provide insights regarding accountancy metrics for different fuel cycle options. These models can also form the base of facility-specific models, which can support licensing applications and facility design. In FY-25, several companies have leveraged SSPM-L base models tailored to their facilities to assist in their accountancy design. Both MAPIT and F3M are open source and available here: here and here. SSPM-L is available on a case-by-case basis. For more information, contact MAPIT-dev@sandia.gov.



Material balance 2 of a generic fuel fabrication model included in SSPM-L.

Principal Investigator Profile: *Nathan Shoman*

Nathan Shoman is a principal artificial intelligence (AI) scientist at Sandia National Laboratory working on the nuclear energy fuel cycle team. He is a classically trained nuclear engineer with bachelor's and master's degrees in nuclear engineering from the University of Tennessee. He has nearly a decade's worth of experience in applied AI. His earliest work started with the application of machine learning for anomaly detection of gamma spectroscopy data collected from Savannah River National Laboratory during his thesis work. Mr. Shoman leads multiple projects in applied AI spanning a range of applications, from deployable in-field computer vision algorithms and offline digital assistants to foundational work in AI-driven design of nuclear systems. His primary research interests focus on AI-driven optimization and design, particularly through hierarchical model-based reinforcement learning systems.

Under MPACT, Mr. Shoman is the lead developer for multiple modeling and simulation software packages used to support nuclear material accountancy. This includes MAPIT, the only open-source nuclear material accountancy software; F3M, an open-source library of nuclear facility modeling tools; and SSPM-L, a library of generic nuclear facility models to support safeguards research. These versatile software packages support a range of activities, from classroom education to the licensing efforts of American companies.

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