



**MPACT**  
Materials Protection Accounting  
and Control Technologies

U. S. DEPARTMENT OF  
**ENERGY**

Office of  
**NUCLEAR ENERGY**

## Materials Protection Accounting and Control Technologies (MPACT) Quarterly Newsletter

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### Program Manager Note

Welcome to the inaugural edition of the Materials Protection Accounting, and Control Technologies (MPACT) newsletter. The MPACT program develops technologies to support Material Control & Accountancy (MC&A) for the U.S. nuclear fuel cycle. MPACT resides in the Department of Energy (DOE) Office of Nuclear Energy (NE) Office of Materials and Chemical Technologies (NE-43) and focuses on the front and back-end of the fuel cycle. This newsletter will be published quarterly with the intent to share recent and planned activities in an accessible format. For more detailed technical updates we encourage you to visit MPACT's website at <https://mpact.inl.gov/> where you can find a program overview, structure, and can download many MPACT publications and technical reports.

The MPACT program mission statement is: The Materials Protection Accounting and Control Technologies (MPACT) campaign supports the U.S. advanced fuel cycles technology developers to effectively and economically address nuclear MC&A (Material Control and Accounting) requirements. Simply stated, we work with fuel cycle developers to identify MC&A technologies and approaches to facilitate the implementation of new U.S. civil nuclear technologies that meet domestic regulatory requirements. In many instances, when the needed MC&A technologies do not exist, MPACT will develop them.

MPACT works directly with the U.S. DOE National Laboratory complex, utilizing both nuclear energy process experts as well as MC&A experts to meet its mission. This cooperation amongst experts, and inclusion of DOE/NE, DOE/NNSA, and DOE/ Office of Science laboratories, supports a Safeguards and

Security by Design (SSBD) approach whereby MC&A can be incorporated into the nuclear process at the earliest stages of development. MPACT also works with the NE University Program (NEUP), the Small Business Innovation research/Small Business Technology Transfer (SBIR/STTR) program, and U.S. nuclear energy industry partners to utilize R&D from multiple programs and apply them to MC&A challenges.

We hope you will find this very first MPACT newsletter informative and interesting and encourage you to reach out to our program contacts if you have any questions or would like to discuss possibly working with MPACT. We are always looking for good ideas and good people!

**Tansel Selekler – MPACT Federal  
Program Manager**



### Principal Investigator Profile: Ammon Williams, Ph. D - Idaho National Lab

Ammon earned his B.S. degree in Mechanical engineering in 2009 from Brigham Young University – Idaho. In 2012, Ammon earned his M.S. degree in Chemical Engineering from the University of Idaho – Idaho Falls Campus. Finally, Ammon received his Ph.D. in Mechanical and Nuclear Engineering from Virginia Commonwealth University in 2016. Since graduation, Ammon has been employed at the Idaho National Laboratory in the Material Minimization, Security, and International Safeguards Group within the Nuclear Nonproliferation Division. Ammon has expertise in high temperature molten salt systems, specifically related to nuclear safeguards and process monitoring of pyroprocessing technologies. Specifically, fission product separation and material tracking via voltammetry and laser-induced breakdown spectroscopy (LIBS). Currently, Ammon is working on a voltammetry project to monitor the operation (specifically oxide and actinide content) of the oxide reduction process which converts light water reactor fuel to metallic form. In addition, Ammon is working on a triple bubbler sensor to measure the density and depth of molten salt contained in the electrorefiner used to recycle used nuclear fuel.

## Program Update

We are now in FY 2025 and it is a good time to review our progress and look forward to new activities. MPACT is a technology R&D program with a strong history developing tools to support domestic safeguards for the U.S. nuclear fuel cycle. In FY24 we continued to build on that history with efforts focused on the front and back end of the fuel cycle as well as activities to support domestic safeguards education.

On the front end of the fuel cycle, MPACT is working to support fuel fabrication Material Control and Accounting (MC&A) for the existing fleet of LWR/PWR reactors by developing an automated hold-up monitor as well as working with partner organizations

to develop Non-Destructive Assay (NDA) standards for waste measurements. MPACT has also begun work on MC&A needs for advanced reactor fuel fabrication facilities. This initial work has focused on identifying technology gaps for the new fuel fabrication processes and material types. We anticipate continuing and expanding this work in FY25, including working with industry to support their MC&A needs as they develop these fuel fabrication techniques.

On the back end of the fuel cycle, MPACT continues to develop safeguards performance models for most major recycling processes. These models help identify areas where MPACT should focus technology R&D. New in FY24 are MPACT cooperation activities with industry who are exploring

possible advanced fuel cycles as part of broader U.S. efforts such as ARPA-E CURIE and ONWARDS. MPACT has several MC&A R&D efforts underway spanning the TRL range to support Used Nuclear Fuel (UNF) recycling.

Finally, in FY24 MPACT has increased efforts focused on domestic safeguards education. We have taken a two-pronged approach, with one thrust developing safeguards practitioner documents, and the second thrust in developing and offering a domestic safeguards course. Combined, these activities seek to develop and sustain current and future safeguards practitioners so that they can support U.S. nuclear facilities for a wide spectrum of operations. Look for the safeguards practitioner documents and course

information on the MPACT website in early FY25 ([mpact.lanl.gov](http://mpact.lanl.gov)).

In FY25, MPACT will continue in these three areas with deeper dives into both the front and back end domestic safeguards R&D. Additionally, MPACT will start a new initiative in FY25 to comprehensively look at advanced fuel cycle domestic safeguards needs. To date, MPACT has focused on individual facilities. With this new initiative, MPACT will look at the fuel cycle as an integrated system and look for gaps and opportunities to apply Safeguards and Security by Design (SSBD) and facilitate MC&A implementation of the future U.S. nuclear fuel cycle.

## MPACT Technical Update Highlight

A challenge for closing the nuclear fuel cycle via pyroprocessing is nuclear material accountancy (NMA) throughout the different processing steps. Of key importance is tracking the nuclear material in the molten salt electrolyte in the Electrorefiner (ER). Over the years, the MPACT program and the Idaho National Laboratory (INL) has Developed a triple bubbler probe to monitor the ER salt density and level in situ. These parameters, combined with analytical concentration data, can yield the total mass of special nuclear material in the ER for NMA. Previous iterations of the triple bubbler were DEPLOYED in the Hot Fuel Examination Facility (HFEF) at INL with success, achieving uncertainties of less than 0.5% for density and 1.5% for level. However, one drawback with the previous design was that it was prone to plugging due to the small diameter dip-tubes (0.15 inch ID) and low gas flow rates (0-6 cm<sup>3</sup>/min).

To mitigate plugging, a new triple bubbler design was developed and tested during FY24. This new design incorporates larger dip-tubes (0.24 inch ID) and the capability of operating at significantly greater gas flow rates (4-200 cm<sup>3</sup>/min). Testing in aqueous fluids and molten salts in the laboratory has shown that the new triple bubbler design is still capable of achieving accurate measurements (0.33% for density and 1.8% for level) while being significantly more robust against plugging. The new design is expected to be Deployed in HFEF in FY25.



Photo showing the size difference between the previous triple bubbler design (left) and the newest design (right).

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**The MPACT newsletter is prepared by INL in coordination with all MPACT labs.**

Idaho National Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratories, Argonne National Laboratory, Oak Ridge National Laboratory, Brookhaven National Laboratory, Los Alamos National Laboratory.