MPACT

Materials Protection Accounting and Control Technologies

Quarterly Newsletter

FY2026 | Q2

PROGRAM MANAGER NOTE

Happy New Year everyone! I know we are already three months into 2026, but we were unable to publish a note in the first quarter of the fiscal year and apologize for the delay. Now we are all back, up and running. We have finalized our FY2026 plans and are excited to share with you all:

First, we have a full slate of technology R & D planned for this year. We are excited to test an Argonne National Laboratory-developed molten salt sampler at the Idaho National Laboratory's Hot Fuel Examination Facility. The sampler is designed to enable on-, at- and offline analysis of molten salt samples. These samples are susceptible to reproducibility challenges due to the collection techniques; the sampler minimizes these variabilities and generates samples that can be analyzed by a host of techniques for both material accountancy and process control purposes.

Next, we are excited for Sandia National Laboratories to complete our first medium-scale safeguards performance model for a TRISO fuel fabrication facility before the end of Q3. We will make this model available to fuel fabricators as soon as it is complete. This model will pair well with our FY2025 Oak Ridge National Laboratory model material control and accountability (MC&A) plan for TRISO fuel fabrication facilities.

Finally (for this newsletter), MPACT will present a series of four webinars designed by Brookhaven National Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratories and Los Alamos National Laboratory on the topic of designing and managing nuclear MC&A systems. These trainings will cover techniques for modeling MC&A flow sheets to assess the efficacy of material balance areas; key measurement points and measurement instruments; an overview of state-of-the-art and high technology readiness level measurement instruments and supporting technology; managing an MC&A program and measurement control programs; and Nuclear Regulatory Commission regulations and regulatory guidance. The series will be conducted online to facilitate broader participation and accommodate participants that have difficulty attending in-person events.

Come visit us at the Institute of Nuclear Material Management conference or the American Nuclear Society Global 2026 conference.

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

Tansel Selekler
MPACT Federal Program Manager

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Principle Investigator Profiles

Kate Schreiber

Katherine (Kate) Schreiber is a scientist in the Safeguards Science and Technology group at Los Alamos National Laboratory. She received a bachelor's degree in physics from the University of Chicago in 2013 and a doctorate in condensed-matter physics from Purdue University in 2018. She was a postdoctoral researcher at the National High Magnetic Field Laboratory at Los Alamos before joining the Safeguards group as a postdoc in 2020. She was converted to staff scientist in 2022.

Schreiber's research primarily focuses on ultrahigh-energy-resolution microcalorimeter detector (microcal) research and development. Her condensed-matter physics background in cryogenics and material properties led her serendipitously to work on microcal, which operate at temperatures below 0.1 kelvin to produce spectra with energy resolution five to 10 times better than commercial high-purity germanium (HPGe) detectors. In collaboration with the National Institute of Standards and Technology and University of Colorado Boulder, Schreiber and the microcal team at LANL research and build ultrahigh-energy-resolution detectors in the X-ray (5-20 keV), gamma-ray (50-300 keV) and total alpha decay (5-7 MeV) energy ranges.

Schreiber leads the MPACT project to deploy, maintain and help perform measurements with the gamma-ray microcal detector at INL's Materials and Fuels Complex Analytical Laboratory. She has been involved with the project since its early stages in 2020 and took over as principal investigator in 2025. She also led the development and deployment of a gamma-ray microcal detector at PNNL and leads the commissioning of more gamma-ray microcal instruments for other sponsors. Schreiber also regularly teaches gamma-ray nondestructive assay techniques for LANL's safeguards technology training program and is one of the NA-241 Safeguards Technology points of contact for LANL.

Callie Goetz

Callie Goetz graduated with her doctorate in experimental nuclear physics from the University of Tennessee, Knoxville's Bredesen Center in 2017. Her postdoctoral appointments involved developing and characterizing new scintillators, and designing a self-powered neutron detector for in-core monitoring in fast-spectrum nuclear reactors. Goetz joined Oak Ridge National Laboratory as an R&D staff member in 2021. She is a member of the Verification Technologies group in the Nuclear Nonproliferation Division. Her areas of expertise include monitoring and verifying technologies in standard and harsh environments, radiation detector development, advanced spectroscopy techniques, and unattended facility monitoring. She applies her expertise to a broad range of application areas including domestic and international safeguards, nuclear nonproliferation, national security, and the nuclear fuel cycle.

Microcal at the Idaho National Laboratory:
Upgrades to better enable ultra precise nondestructive analysis

The microcal at INL's Materials and Fuels Complex Analytical Laboratory — known as the High Efficiency and Resolution Microcalorimeter Spectrometer, 400 pixels (HERMES-400) — is preparing to perform a suite of measurements for nuclear fuel cycle-relevant materials. HERMES is a gamma-ray spectrometer capable of producing spectra of energy resolution of up to 10 times better than HPGe detectors, the current commercially available standard (figure 1). The ultrahigh-energy resolution will provide higher accuracy and precision in characterizing actinides and fission products in materials such as TRISO samples and electrorefiner salts. The microcal gamma-ray measurements could complement destructive analysis techniques to enhance and expedite characterization of these materials.

Microcal detectors work by operating tiny, superconducting sensors at ultralow temperatures, typically 80-100 millikelvin. At such low temperatures, these sensors are sensitive to the heat deposited by a single gamma ray. Like a small ultrasensitive thermometer, the heat pulse from the gamma ray is measured as a small change in current through the sensor, producing an electrical pulse. These pulses are collected and binned into gamma-ray spectra. To create a spectrum with appreciable counting statistics, the HERMES detector is composed of approximately 400 individual superconducting sensor pixels — among the largest gamma-ray microcal arrays yet developed (figure 2). The detector arrays are housed in an ultracold cryostat called a dilution refrigerator in the basement of the MFC Analytical Laboratories (figure 3).

INL received the HERMES microcal in 2022 and it has since undergone various upgrades. The last planned upgrade is expected this spring, in which LANL and NIST/University of Colorado collaborators will upgrade the cryostat mounting for the microcal pixel arrays. The design, informed by a sibling HERMES instrument at PNNL, will allow the detectors to face sideways and reduce vibrational noise that can affect measurements. With these detector improvements, the instrument will again launch into nuclear fuel cycle measurements for the Analytical Laboratories.

Reference: [1] K.A. Schreiber et al. (2025) Applications of ultra-high resolution microcalorimeter gamma-ray spectrometry. Front. Nucl. Eng. 4:1654123. doi: 10.3389/fnuen.2025.1654123

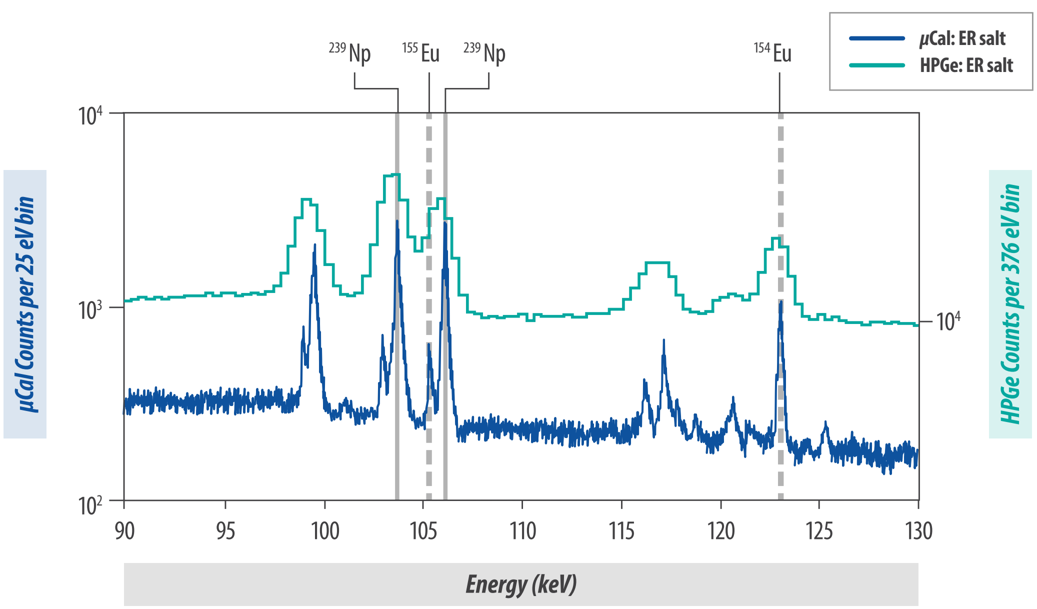

Figure 1 – *Electrorefiner salt spectra from HERMES-400 at INL and from HPGe. The microcal spectrum resolves closely spaced peaks. Notably, clear resolution is given for peaks from Europium-155, a fission product, and neptunium-239, an actinide, which will improve uncertainty in actinide characterization. The Eu-155/Eu-154 peak areas could be compared as a cooling time estimate. From ref. [1]*

Figure 2 – *Microcalorimeter array module of ~100 superconducting pixels, seen on top of the module. Each pixel is 1.5 mm by 1.5 mm in area. Four of these modules are installed in HERMES-400. Specially microfabricated chips for detector readout are seen on the four sides.*

Figure 3 – *HERMES-400 collaborators from LANL and INL in front of HERMES-400 in the basement of the MFC Analytical Laboratories. From left to right: Mark Croce, LANL; Kate Schreiber, LANL; Paige Abel, INL; Brian Bucher, INL.*

Holdup Monitors

Nuclear facilities that process fuel and dispose of waste employ high-efficiency particulate air filtering to prevent special nuclear material from escaping into the environment. Some escape of material into the ductwork beyond the filters is inevitable — this material is called holdup. Holdup surveys require personnel to transport detectors to often difficult-to-reach locations within the facility, sometimes requiring remote measurements or detectors placed on long poles to reach necessary measurement points. To address these challenges, Oak Ridge National Laboratory is developing holdup monitors that can operate in two modes: permanently installed distributed or "hub" mode, and standalone mode intended for temporary placements and spot checks. These detectors provide significant advantages over the current options.

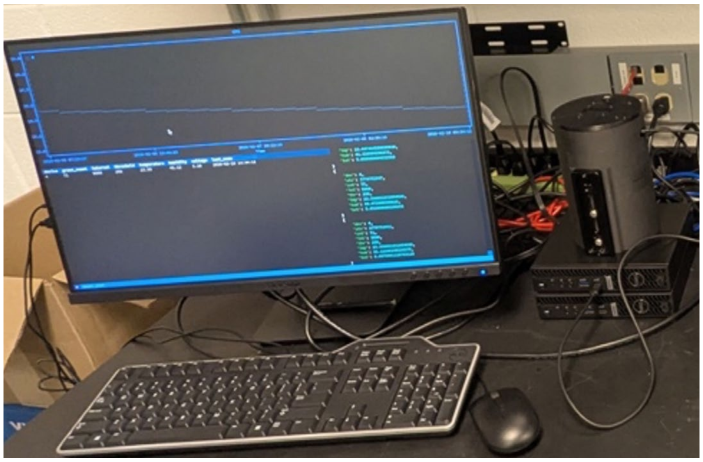

Figure 1 – *Single detector (right) operating in "hub" mode with count rate history and detector status displayed on screen.*

Figure 2 – *Single detector operating in "standalone" (battery-powered) mode. Current count rate is displayed on screen with time stamped data saved locally on nonremoveable storage.*

They can report on up-to-date facility conditions including adverse events such as filter failure, automate materials control and accountancy in measurement locations, reduce systematic error associated with mobile measurement, and could even provide online process monitoring information. The team developed a system that cost less than $500 per unit in 2025, making automated holdup monitoring a financially beneficial alternative to manual monitoring for commercial nuclear facilities. Ongoing developments on the project include extensive field testing, implementing spectroscopic capability in firmware, temperature bias control to allow the units to be deployed outdoors, and algorithmic development for materials control and accountancy and facility monitoring purposes.

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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.

LA-UR-26-22169 24-50722

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