



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

**Nuclear Energy University Programs (NEUP)
Fiscal Year (FY) 2017 Annual Planning Webinar**

**Nuclear Materials Control and
Instrumentation (FC-3)**

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FC: 3 Next Generation Nuclear Materials Management

■ **Mission** – Develop innovative technologies and analysis tools to enable *next generation nuclear materials management* for existing and future U.S. nuclear fuel cycles, to manage and minimize proliferation and terrorism risk.

■ Objectives

- Develop and demonstrate advanced material control and accounting technologies that would, if implemented, fill important gaps
- Develop, demonstrate and apply MPACT analysis tools to assess effectiveness and efficiency and guide R&D
- Develop tools, technologies, and approaches in support of used fuel safeguards and security for extended storage, electrochemical processing, and other advanced nuclear energy systems
- Perform technical assessments in support of advanced fuel cycle concepts and approaches
- Develop guidelines for safeguards and security by design and apply to new facility concepts

Technology Development

Applications

Leadership

MPACT Campaign – 5-Year High Level Milestones

- **Develop field test plans for at least two promising new instrumentation technologies (*completed*)**
- **Initiate at least three new exploratory instrumentation projects**
- **Develop an integrated approach for EChem safeguards and security**
- **Test at least two technologies for EChem safeguards and security**
- **Perform sensitivity studies for EChem safeguards and security performance**
- **Develop a risk-based concept and approach for safeguards and security of used fuel extended storage**
- **Develop physics-based time-dependent signatures to guide advanced monitoring technology development**
- **Perform consequence and vulnerability assessments of used fuel extended storage and advanced nuclear energy systems of interest**

2020 Milestone – complete lab-scale demonstration of advanced safeguards and security system

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Long Term Objectives (10 – 20 years)

- **Help to establish Safeguards and Security by Design as a standard paradigm for nuclear energy systems**
- **Demonstrate and implement next generation nuclear materials management technologies and approaches**
 - Echem, H-Canyon, bilateral engagements, new fuel cycle facilities,...
- **Address safeguards and security issues associated with technology development in other Campaigns**
- **Support NRC rulemaking through engagement and data generation**
- **International engagement to help influence and support the nuclear energy enterprise and demonstrate U.S. leadership**

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Advanced Process Monitoring for Domestic Nuclear Safeguards (FC-3)

Sensors, techniques, and approaches for integrative advanced process monitoring to enhance nuclear material control and accounting in used nuclear fuel reprocessing facilities. This area includes radiation based and non-radiation based approaches with the goal of providing quantitative analysis to supplement traditional nuclear material control and accounting measures resulting improved performance of the safeguards system to meet NRC Material Control and Accountability (MC&A) requirements.



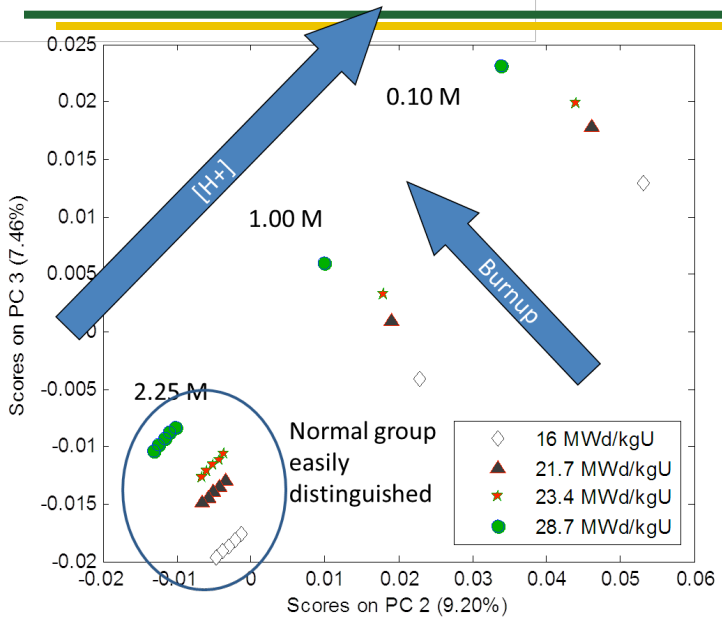
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Backup



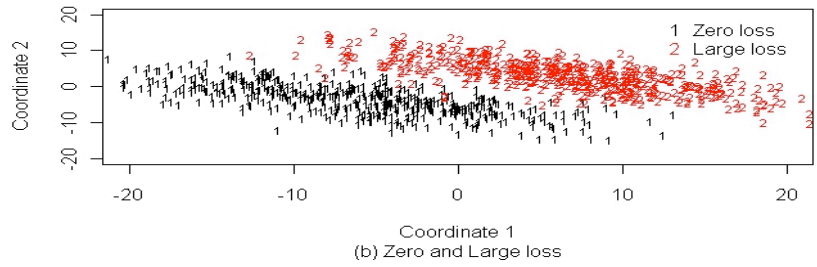
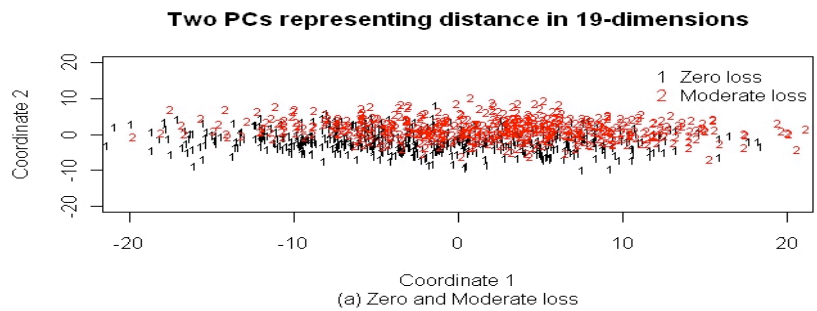
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Multi-Isotope Process Monitor and Pattern Recognition



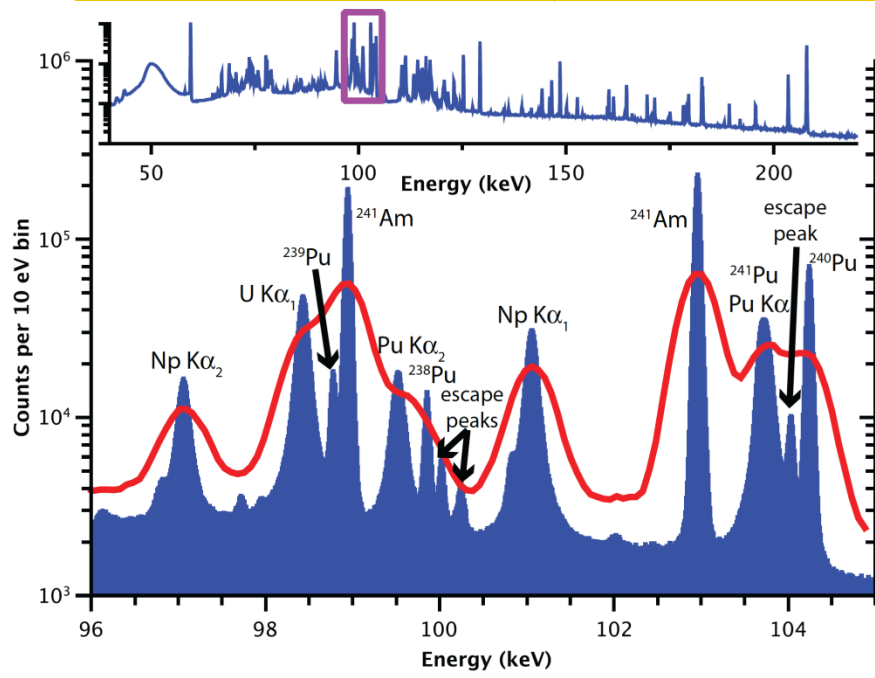
- Correlation of multiple isotopes via gamma spectroscopy to enable detection of process changes

- Pattern recognition of multivariate data – putting process monitoring on equal footing with nuclear material accountancy



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Super-High Resolution Gamma-Ray Spectroscopy



- Significant improvement in the uncertainty of Pu isotopic determination demonstrated

- Cryogenic gamma-ray spectroscopy has demonstrated 10x improvement in resolution over HPGe

