INL-MIS-15-36794
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INL and the Consortium for Verification Technology

INL Support in FY2015 and Capabilities and Resources for Future Support

October 2015

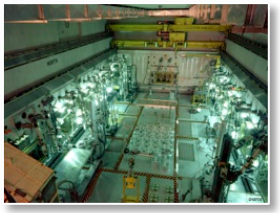
David Chichester, Distinguished Staff Scientist
Nuclear Nonproliferation Division
National & Homeland Security Science and Technology Directorate

Idaho National Laboratory

Our Mission
Discover, demonstrate and secure innovative nuclear energy solutions, other clean energy options, and critical infrastructure.
INL
Idaho National Laboratory
Our Vision
INL will change the world's energy future and secure our critical infrastructure.

Idaho National Laboratory

- ~3800 employees
- 890 square miles
- 111 miles of electrical distribution lines
- 579 buildings
- 177 miles of paved roads
- 14 miles of railroad lines
- 4 reactors
- Mass transit system
- Protective security force
- Multiple irradiated-fuel storage pools
- Dry-cask fuel storage research testbed



CVT Activities at INL – Infrasound

- In May INL hosted Dr. Milton Garces and Mr. Anthony Christie of the University of Hawaii, Manoa, for a week-long scoping study exploring the infrasound signatures present at nuclear facilities.
- Acoustic observations were taken across the INL site including:
  - Advanced Test Reactor (research reactor)
  - Hot Fuel Examination Facility (hot cell)
  - Analytical Laboratory (a radiochemistry laboratory with hot cells and glove boxes)
- Work is underway examining the potential use of this type of data for verification; further observations are planned

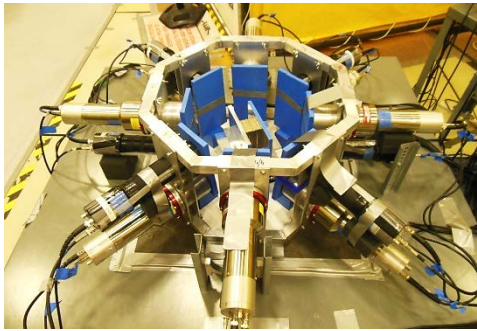
Colling fan duct and the exhaust stack at ATR

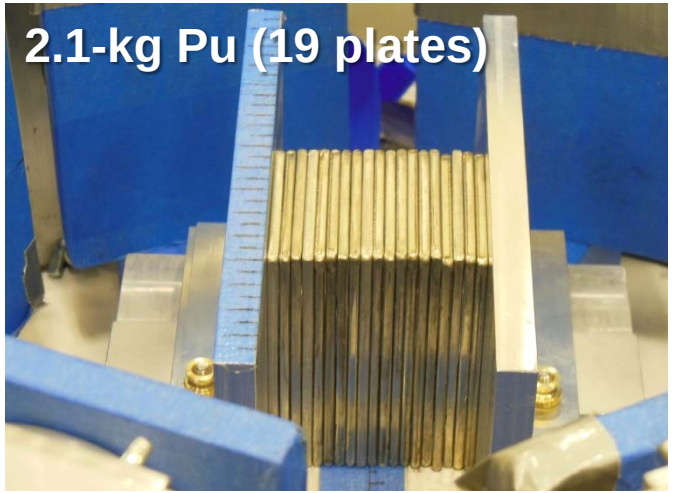
Infrasound Laboratory of the University of Hawaii

INL Nonproliferation Seminar, May 22

CVT Activities at INL – Fast-Neutron Multiplicity Analysis

- In August INL hosted Dr. Angela Di Fulvio of the University of Michigan for a week-long experiment campaign at INL's ZPPR facility
- Two types of clad plutonium plates
  - 110.7-g Pu, 72.0% ^{239}Pu
  - 105.3-g Pu, 93.9% ^{239}Pu
- 16-channels of data





Detection for Nuclear Nonproliferation Group

CVT Summer Interns at INL

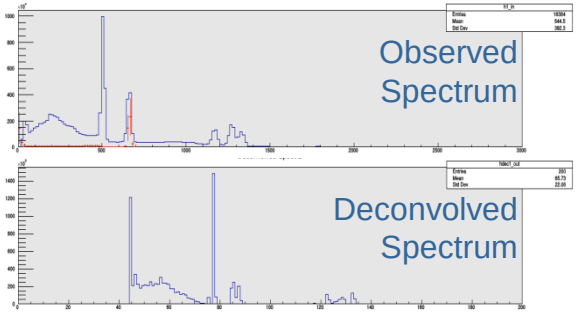
Daniel Shy

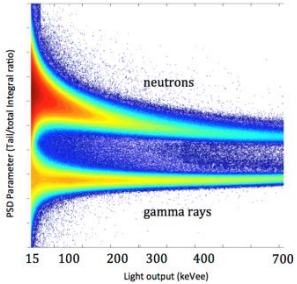
- U. Michigan
- Optimization of inorganic scintillator detectors to improve gamma-ray spectroscopic performance
- Development of spectral deconvolution methods interpreting gamma-ray spectra

White-water rafting on the Snake River, August, 2015

Charles Sosa

- U. Michigan
- Optimization of organic scintillator detectors to improve neutron/gamma-ray pulse shape discrimination (PSD)
- Evaluation of optimal waveform digitization parameters to maximize PSD performance of organic scintillators





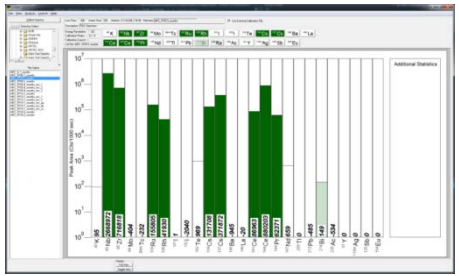
PSD-focused optimization aimed at further separating neutron and gamma-ray signals

INL Capability Alignment with the CVT Thrust Areas

Thrust Areas	Sub Areas	INL Staff	INL Resources
1: Characterizing Gaps & Emerging Challenges	FMCT Verification Challenges	✓	✓
	Future Disarmament Treaties	✓	✓
2: Fundamental Physical Data, Data Acquisition & Analysis Techniques	Physics of Fission	✓	✘
	Data Analytics	✓	✘
	Data Acquisition for High-Throughput Radiation Detector Systems	✓	✓
3: Advanced Safeguards Tools for Accessible Facilities	Neutron Multiplicity Counting	✓	✓
	Handheld/Portable Room Temp. Semiconductor γ-Ray Imagers	✓	✓
	Stand-off Meas. using LIBS for Limited Access Areas	✓	✓
	Chain-of-Custody Detectors	✓	✓
4: Detection of Undeclared Activities and Inaccessible Facilities	Seismic Signatures	✘	✓
	Infrasound Signatures	?	✓
	Atmospheric Radionuclide Sensing	✓	✓
	Signatures from Undeclared Fuel-Cycle Facilities	✓	✓
5: Disarmament Verification	Rad. Detection Systems for Arms Control & Treaty Verification	✓	✓
	Warhead Dismantlement Facility & Managed-Access Simulator	✓	✓
	Zero-Knowledge Neutron-based Verification System	✓	✓
	Limited Knowledge Transmission NRF	✓	✓
6: Education & Outreach	Multiple	✓	✓

INL Research Staff Interests Aligned with the CVT

- Automated, information-barrier software for assessing gamma-ray spectra for CTBT on-site inspections
  PI: Gus Caffrey TA: 1, 5, & 6
- Study of nontraditional signatures and observables associated with reprocessing LWR fuel; evaluation of forensic signatures from LWR fuel
  PI: Kevin Carney TA: 1, 4, & 6
- Development of passive and active interrogation methods for characterizing assemblies of SNM for safeguards, arms control, and treaty verification
  PI: David Chichester TA: 1, 2, 3, 5, & 6
- Methods and instrumentals for ultra-trace mass and radiochemical analyses and the production of reference materials
  PI: Matt Watrous TA: 1, 4, & 6



Screen shot of the OSIRIS user interface, showing results of allowed gamma-ray results

Disassembly of an LWR fuel pin at INL for follow-on radiochemical analyses

Source-assisted multiplicity counting to determine multiplication, M, of an assembly of HEU

Potential INL Resource Support for the CVT

Working with Bulk SNM
(Thrust Areas: 1, 2, 3, 5, & 6)

Active interrogation & multiplicity counting for SNM detection and characterization

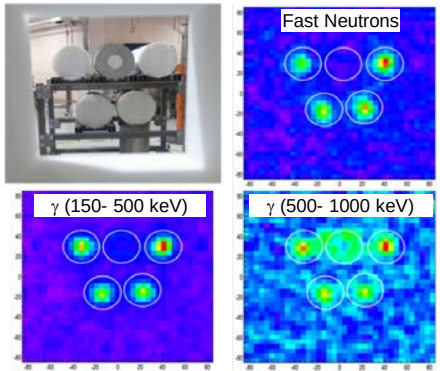
U & Pu Processing Facilities
(Thrust Areas: 1, 3, 4, & 6)

Hot-cell facilities processing irradiated fuel; U and Pu radio-chemistry

Explosives Test Range
(Thrust Areas: 4)

Large explosives test range supporting outdoor RDD detonation events

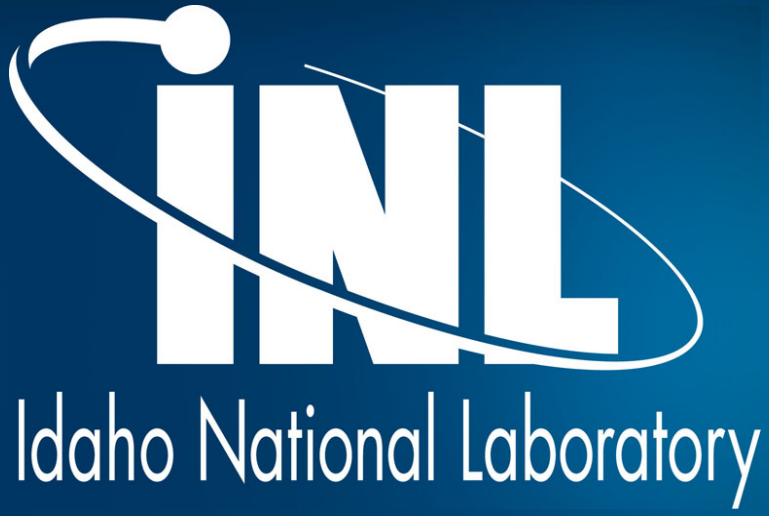
Radiation Imager Trials
(Thrust Areas: 3 & 5)



Assessing imaging systems for arms control and emergency response (example data from an ORNL system)

PUREX Pilot Plant
(Thrust Areas: 1, 2, 4, & 6)

Engineering-scale solvent extraction pilot plant for non-proliferation R&D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