

Recruiting and Training the Next Generation of Nuclear Forensic Scientists at the Savannah River National Laboratory

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Presentation to CSIS: Project on Nuclear Issues

SRS and the Savannah River National Laboratory

SRS founded in 1950s to make plutonium and tritium ~310 sq. miles

- 5 operating production reactors
- 2 separation canyons
- Fuel fabrication
- Tritium facility
- SR Lab supported process development for the Plant (Site)
 - Also provided environmental monitoring research



Designated a National Laboratory in 2004

•3 primary technical directorates

- **National & Homeland Security**
 - Nuclear Forensics Analysis Center (NFAC)
- **Energy Security & Engineering**
- **Environmental & Chemical Process**

Nuclear Forensics Analysis Center (NFAC)

- **Currently housed in the National & Homeland Security Directorate, NTS**
 - Brings together chemistry, physics, engineering, oceanography, meteorology, nuclear engineering, biology, material science
- **Funding from**
 - DOE-NNSA
 - DHS/DNDO
 - FBI
- **Goal is to provide information about nuclear materials**
 - What is the material? What threats does it present?
 - Where did it come from? Domestic or Foreign source?
- **NFAC scientists do NOT do Attribution (analysts do that!)**
 - When and how was control lost?
 - Who are the bad guys?



Current SRNL Analysis Capabilities

Instruments

- Thermal ionization mass spectrometer (not in rad. labs) most sensitive
- Inductively coupled plasma mass spectrometer (2 clean 1 rad.)
- Underground counting facility (4 ultra sensitive gamma spectrometers)
- Alpha spectrometers
- Liquid scintillation spectrometry (beta)

Some sensitivities

- Detection of Pu down to a femtogram (1×10^{-15} g)
- Able to obtain full Uranium isotopics down to ~1 nanogram (10^{-9} g)
- Detect Cs-137 down to 1 picoCi (10^{-12} Ci)



Challenges to Nuclear Forensics Mission

- “At present, personnel skilled in nuclear forensics at the national laboratories are too few and are spread too thinly. **Furthermore, a substantial fraction of the experienced personnel are retired, now eligible for retirement, or nearing retirement age.** The university pipeline produces too few people in needed specialties...”

from: **Nuclear Forensics: A Capability at Risk**, Committee on Nuclear Forensics; National Research Council (2010)



NUCLEAR FORENSICS A CAPABILITY AT RISK (Abbreviated Version)

Committee on Nuclear Forensics

Nuclear and Radiation Studies Board
Division on Earth and Life Studies

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- Across SRNL, expected retirement of 2/3 of work force within 10 years
- Significant impact on NFAC program
 - If not addressed, will diminish existing capabilities
 - loss of accumulated knowledge and experience
- Currently, few programs exist to train next generation of nuclear forensic scientists
- Need to recruit new people and develop new training programs

What is SRNL doing to address these issues?

- Fostering university collaborations at both the undergraduate and graduate level
- Successful post doctoral research program
- Recruiting highly qualified scientists from variety of scientific disciplines and exposing them to nuclear forensic science
- **Goal: expand the available scientific talent pool and bring expertise from various scientific disciplines to nuclear forensics**

Nuclear Forensics Scholarships

- **Sponsored by** U.S. Department of Homeland Security Domestic Nuclear Detection Office (DHS/DNDO)
 - **Nuclear Forensics Undergraduate Scholarship Program (NFUSP)**
 - Introduces nuclear forensics as a career option for students studying physics, chemistry, nuclear engineering, and materials science
 - Hands-on experience through 9 - 12 week summer research program at national laboratories
 - **Nuclear Forensics Graduate Fellowship Program (NFGF)**
 - Supports graduate student research, in collaboration with SRNL scientists, to develop new analytical tools for applications in nuclear forensics
 - Simultaneously provide nuclear forensics training to graduate students early in their careers

SRNL is participating and looking for good students!

Current SRNL Collaborations

- **University of Missouri**

- Signature development to attribute Ir-192 sources
- Background work being performed by NF fellowship student
 - Dissolution method development
 - Background contaminants
- Use developed methods in SRNL Shielded Cells to analyze real source

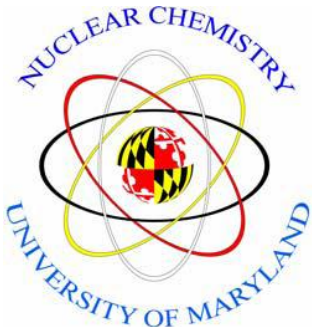


- **University of Maryland**

- Analytical method development - determination of rare earth element isotope ratios to attribute source
 - Separation and purification methodology being developed at U MD
 - Use developed techniques to analyze spent fuel samples at SRNL

- **University of Cincinnati**

- Validation of methods used for nuclear forensics at the SRNL
 - Age dating of nuclear materials
 - Initial method validation and spike calibration being performed at the UC by Nuclear Forensics Fellow
 - Perform analyses at SRNL on archived materials to provide validation data to sponsors using SRNL equipment and facilities



SRNL Post Doctoral Fellowship Program

- Fellowships available in a variety of research areas, not limited to nuclear forensics
- Currently ~25 Post docs working across SRNL, with ~ 4 participating in the nuclear forensic effort
- Includes chemists, physicists, materials scientists, nuclear engineers, and others, engaged in experimental and modeling research
- Several scientists originally hired as post docs in other SRNL research areas have become permanent laboratory staff members supporting the NFAC mission

Bringing New Scientists into the Field... Recent Examples

- **Education: B.S. in Chemistry, PhD in Materials Science**
 - Post Doc at SRNL in Energy Security Directorate
 - no formal nuclear forensics experience
 - skill set and interests are a good match for many aspects of the work
 - **Currently: Senior Scientist**, material characterization of nonproliferation signatures which involves regular analysis with a wide variety of analytical instrumental methods
- **Education: B.S. in Chemistry, PhD in Physical Chemistry**
 - National Research Council Post Doc at the Space Vehicles Directorate of the Air Force Research Laboratory
 - No previous experience in nuclear forensics
 - Extensive training in mass spectrometry
 - **Currently: Senior Scientist**, using MC-ICPMS to measure isotopic signatures
- **Mentored by a variety of scientists with expertise in the broad field of nuclear forensics, including nuclear chemists, nuclear physicists, and reactor physicists.**

Conclusions

- Availability of future work force with appropriate training is a recognized problem in the nuclear forensic field
 - Impending retirement of significant portion of current work force
 - SRNL and NFAC capabilities will be affected
- Currently adopting measures aimed at minimizing impact
 - Through DHS/DNDO, sponsor Nuclear Forensic Scholarship programs in conjunction with university partners to support promising students
 - Continue successful post doctoral research program to attract and train young scientists in nuclear forensics
 - Recruit scientists from a variety of backgrounds who possess appropriate skill sets to maintain continuity as well as support future growth of the field