National Nuclear Security Administration
Defense Nuclear Nonproliferation
Research & Development
(DNN R&D) Program

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“There is no greater threat to the American people than weapons of mass destruction, particularly the danger posed by the pursuit of nuclear weapons by violent extremists and their proliferation to additional states. That is why we are pursuing a comprehensive nonproliferation and nuclear security agenda…”

— National Security Strategy, May 2010

“We know that there is unsecured nuclear material across the globe. To protect our people, we must act with a sense of purpose without delay. So today I am announcing a new international effort to secure all vulnerable nuclear material around the world. We will set new standards, expand our cooperation with Russia, pursue new partnerships to lock down these sensitive materials.”

- President Obama, April 2009
Vision: We are committed to making the world a safer place by reducing nuclear and radiological dangers.

Mission: To develop and implement technical and policy solutions to eliminate proliferation-sensitive materials and limit or prevent the spread of materials, technology, and expertise related to nuclear and radiological weapons and programs around the world.

Core Competencies:
1. Remove, eliminate and minimize the use of proliferation-sensitive materials.
2. Safeguard and secure nuclear and radiological materials, technologies, and facilities.
3. Detect and prevent the illicit trafficking of nuclear/radiological materials, technology, information and expertise.
4. Provide R&D technology solutions for treaty monitoring, minimizing the use of proliferation-sensitive materials, and the application of safeguards and security.
5. Provide unique technical/policy solutions and develop programs стратегies to reduce nuclear/radiological dangers.
Reduce the threat to national security posed by the proliferation of nuclear weapons or materials by developing the U.S. capabilities to monitor nuclear treaties, weapons development activities, and detonations worldwide.

**Proliferation Detection**

** Nuclear Proliferation Monitoring**
Develop advanced technologies and capabilities to detect all aspects of foreign nuclear weapons development processes.

** Nuclear Security**
Develop advanced technologies and capabilities to detect the movement and diversion of nuclear weapons and special nuclear materials.

**Nuclear Test Monitoring**
Develop and produce advanced technologies and capabilities to detect, identify, and characterize global nuclear detonations.
Manage an integrated R&D portfolio that delivers advanced technical capabilities to:

- Detect and characterize foreign nuclear weapons development activities
- Support nuclear arms control treaty verification and monitoring for compliance
- Support broader U.S. nuclear security missions, including counter nuclear terrorism
Proliferation Detection Teams

- **Nuclear Weapons Development and Material Production Detection**
  - develops in situ, near-field, and remote capabilities for detecting signatures and observables of weapons development/fuel cycle processes
  - emphasis is with unilateral capabilities or those applied in a non-cooperative environment

- **Nuclear Weapons and Material Security**
  - develops radiation sources and sensors for detecting material diversion, movement, and life-cycle continuity-of-knowledge of warheads and material
  - emphasis is with multi-lateral capabilities or those applied in a cooperative environment

- **Nonproliferation Enabling Capabilities**
  - develops cross-cutting, supportive technologies, such as modeling, simulation, and remote sensing tools that are critical for meeting PD metrics for demonstrating broader capability advancements in MPD and WMS
  - can be applied in both cooperative and non-cooperative environments
Weapons Development & Material Production Detection Technical Focus

U-235 Production Detection
Signature detection, facility characterization, EM, Conversion, Enrichment, Metal Production

Pu Production Detection
Reactor monitoring, reprocessing, pyroprocessing, zeolites/MOF, Moran Solvent Test Bed

Other Nuclear Processes
Backgrounds/interferences, other SNM processes

Weapons Development Detection
Source term extension, machine metal shaping, acoustics, EM, hydrotest

Mass Spectrometry
SIMS, ICP-MS, laser techniques, workshops, micro-scale automation (TIMS)
Nuclear Weapons & Material Security
Technical Focus

Arms Control
Warhead Measurement Campaign, confirmation and dismantlement methods, Information Barriers

International Safeguards
Tags and Seals, Improving nuclear measurements

Detectors & Sources
Radiation Materials, detectors, photon sources
CZT, 3He replacements, detectors & N Sources; for scintillators & semiconductors, Laser Wakefield

Interdiction & Emergency Response
Maritime detector test, 3D-GADRAS, Device Diagnostics

Radiological Source Replacement
AmBe replacement for well logging; Tags; 99.9% SBIR
Enabling Capabilities
Technical Focus

Remote Sensing
Advanced capabilities to target activities and materials of interest remotely

Data Analytics, Modeling, and Simulation
Novel methodologies and techniques to explore and analyze data

Signature Physics
Novel theoretical and predictive capabilities to enable signature discovery across the PD mission space
Other Proliferation Detection Activities

- **Technical Support to Nuclear Counterterrorism and Incident Response (NCTIR)**
  - long-term R&D needs for detecting, characterizing and responding to unconventional nuclear explosives designs and configurations

- **Nuclear Nonproliferation and Verification Test Beds**
  - operational demonstrations and research that supports U.S. capabilities to monitor and verify international treaties and cooperative agreements

- **University Program**
  - support university research that complements and links with laboratory research in nuclear science and security

- **Small Business Innovation Research/Small Business Technology Transfer**
  - support small business commercialization pathways
Nuclear Detonation Detection Mission

- Manage an integrated R&D portfolio that delivers advanced technical capabilities across the USG to:
  - Improve geophysical and radionuclide methods of nuclear test treaty monitoring
  - Advance technical nuclear forensics capabilities
- Develop and build space-based sensors for nuclear test treaty monitoring and military missions
Nuclear Detonation Detection Teams

- **Space-based Nuclear Detonation Detection**
  - develops R&D to build space-based payloads of sensors to rapidly identify and characterize detonations in atmosphere or space for treaty monitoring and military tactical warning

- **Ground-based Nuclear Detonation Detection**
  - develops R&D to improve detection and analysis of signals from underground nuclear detonations

- **Forensics-based Nuclear Detonation Detection**
  - develops R&D to improve the U.S. nuclear forensics capability to identify distinguishing characteristics and potential provenance of interdicted nuclear materials, devices, or nuclear detonations of unknown origin
Nuclear Detonation Signatures

**Space NUDET**
- Gamma-Ray
- Neutron
- X-ray

**Transition-Region NUDET**
- Optical
- Gamma-Ray
- Neutron

**Low-Altitude NUDET**
- Optical
- Electromagnetic Pulse
- Infrasound
- Radionuclide

**Sub-Surface NUDET**
- Hydroacoustic
- Seismic
Space-Based Technical Focus

Next-Generation Sensors Research
Apply Commercial Off The Shelf solutions and novel sensor systems to increase capabilities while minimizing expenses.

Optimizing Configuration of System Architecture
Study sensor configuration, alternate support systems, and new performance prediction models to meet requirements at lower cost.

GPS Nuclear Detonation Sensors
Fabricate optical, x-ray, and EMP sensor payloads to sustain the U.S. Nuclear Detonation Detection System hosted on the GPS satellite constellation.

Geosynchronous (GEO) Nuclear Detonation Sensors
Fabricate neutron and gamma ray sensor payloads to maintain the U.S. Nuclear Detonation Detection System hosted on GEO satellites.
Ground-Based Technical Focus

**Seismic Modeling**
Provide a physical basis to predict the seismic disturbances arising from any source in a variety of emplacements.

**Sensors**
Improve sensor sensitivity, signal-to-noise ratio, and frequency bandwidth while reducing cost.

**Signal Analysis**
Make full use of the entire signal for nuclear explosion monitoring.

**Signal Propagation**
Predict seismic signals that result from a natural or manmade disturbance to locate, identify, and quantify the magnitude of the event.
Forensics-Based Technical Focus

Provenance of Interdicted Nuclear Material
Determine the type of environment it has been in.

Interdicted Devices
Identify signatures to characterize pre-detonated devices.

Post-detonation Data Evaluation
Develop more timely, accurate, discriminating, and robust technical methods to answer nuclear forensics questions.

Defense Nuclear Nonproliferation R&D
The NNSA Graduate Fellow Program

Who is this fellowship for?
- Highly motivated graduate-level students and recent graduates interested in exploring a career in nuclear security

Fellow Assignments
- Policy Emphasis
- Technical Emphasis
- Operational Emphasis

Application Deadline for 2016
- October 19, 2015

Website
- http://ngp.pnnl.gov

Salary and Benefits
- Annual salary: $52,000 ($62,000 for post-doctoral Fellows)
- $3,000 recruitment incentive
- Health and dental plans, paid vacation and holidays, relocation stipend, Tuition reimbursement
The NNSA Graduate Fellow Program

Who is NA-22 looking for?
- Science and technology graduates
- Those who want to participate in a science and technology enterprise
- Those who want to explore alternatives to industry or academia
- Those interested in national security and public service
- Self starters

What does NA-22 want to achieve?
- Recruit and prepare our replacements
- Develop generalists in non-proliferation technologies
- Expose fellows to science funding management and methodologies
Fellow Assignments

- Travel to national labs to meet with project PIs
- Attend key interagency meetings as NNSA representative
- Attend conferences and speaker series on arms control and other nuclear related topics in DC
- Create factsheets for various technologies developed under NA-22 funding
- Review and provide opinions on research proposals
- Attend highly specialized training and technical tours
- Write review reports on current status of technologies
- Contribute to independent reviews of NNSA funded projects
Summary

- The Office of Defense Nuclear Nonproliferation R&D is the leading USG organization for the development of new technology in support of the US Government’s nuclear nonproliferation goals.
- Success with our broad investment portfolio relies on great teamwork between HQ and our exceptional National Laboratory workforce.
- NA-22 is looking for science and technology graduates who are interested in national security.
- Develop generalists who understand nuclear security technologies and their scientific underpinnings.
- Expose fellows to methodologies that apply in funding and managing endeavors in and S&T enterprise.
- Train those who will replace and succeed current NNSA and other nuclear security enterprise staff.