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

Craig Sloan
Director, Office of Proliferation Detection

Presentation to the Consortium for Verification Technology Workshop
29 November 2017

National Nuclear Security Administration

Overview

- National Nuclear Security Administration Mission
- Defense Nuclear Nonproliferation R&D
  - Current Programs
  - Future Activities
- Opportunities for students

NNSA Missions and Crosscutting Capabilities

National Nuclear Security Administration

National Nuclear Security Administration

Under Secretary for Nuclear Security & Administrator NNSA

Lt Gen Frank G. Klotz, USAF (Ret)

Principal Deputy Administrator: *Vacant*

Deputy Admin. for Defense Programs *Philip T. Calbos (Acting)* *NA-10*	**Deputy Admin. for Defense Nuclear Nonproliferation** *David Huizenga (Acting)* *NA-20*	**Deputy Admin. for Naval Reactors** *ADM James Caldwell, USN* *NA-30*	**Assoc. Admin. for Emergency Operations** *Charles L. Hopkins III* *NA-40*	**Assoc. Admin. for Safety, Infrastructure and Operations** *James J. McConnell* *NA-50*	**Assoc. Admin. for Def. Nuclear Security & Chief, Defense Nuclear Security** *Jeffrey R. Johnson* *NA-70*
Assoc. Admin. & Dep. Under Sec. for Counterterrorism & Counterproliferation *Jay Tilden* *NA-80*	**Office of the General Counsel** *Bruce Diamond* *NA-GC*	**Assoc. Admin. for Management & Budget** *Randall M. Hendrickson* *NA-MB*	**Assoc. Admin. for Information Management & CIO** *Wayne Jones* *NA-IM*	**Associate Admin. for External Affairs** *Nora Khalil* *NA-EA*	**Associate Admin. for Acquisition & Project Management** *Robert B. Raines* *NA-APM*

Kansas City Field Office *Mark Holecek*	**Livermore Field Office** *Peter Rodrik*	**Los Alamos Field Office** *William Goodrum*	**Nevada Field Office** *Steven Lawrence*	**NNSA Production Office** *Geoffrey Beausoleil*	**Sandia Field Office** *Jeffrey P. Harrell*	**Savannah River Field Office** *Doug Dearolph*

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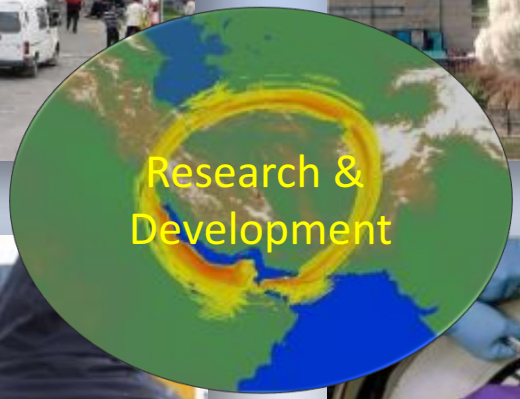
Defense Nuclear Nonproliferation

Mission: *Develop and implement policy and technical 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.*



Vision: *We are committed to making the world a safer place by reducing nuclear and radiological dangers.*

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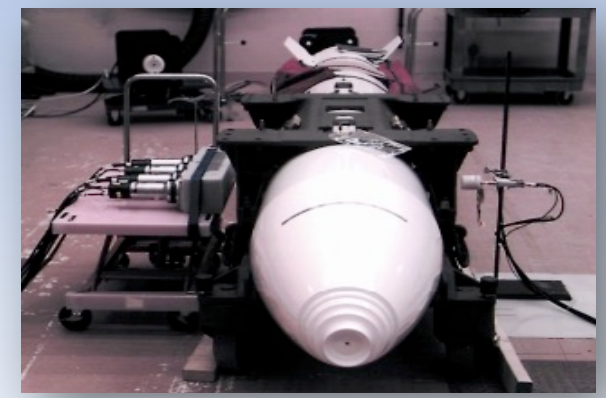
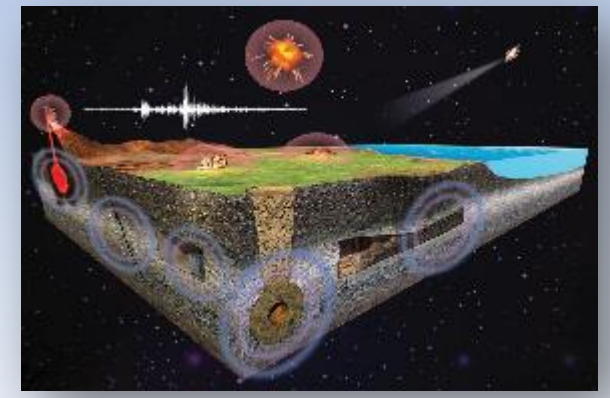
DNN Research & Development Mission and Goals

Develop advanced technical capabilities in support of U.S. national nuclear security and nonproliferation goals

Nuclear Proliferation Detection
Strengthen U.S. capabilities to detect and characterize foreign nuclear programs.



Nuclear Security Applications
Advance U.S. capabilities to strengthen nuclear security across the threat spectrum.



Nuclear Explosion Detection
Improve U.S. capabilities to detect and characterize nuclear explosions.

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DNN R&D Organization

Assistant Dep. Administrator
Edward Watkins
Assoc. Asst. Dep. Administrator
David LaGraffe
Senior Science Advisor
Darcie Dennis-Koller

Front Office Staff
Michelle Livingston
Ivy Martin
Timothy Ault, Fellow
Noel Nelson, Fellow
Blake Palles, Fellow
Sid Bartlett, CTR
Danika Mars, CTR
Travis Gitau, CTR

Office of Proliferation Detection
Craig Sloan, Director
LTC Ben Miller, Dep. Director
Patria Smith, CTR

Program Managers	Technical Advisors
Craig Sloan (Nuclear Test Detection)	*Roger Petrin, LANL*
LTC Ben Miller (Signatures and Data Science)	*Kevin Jackman, LANL*
Allen Bakel (U and Pu)	*Chris Pickett, ORNL*
Victoria Franques (Innovation)	*Scottie Walker, SNL*
Donny Hornback (Near-field Detection)	*Riad Manaa, LLNL*
LTC Michael Koehl (Emergency Response)	*Frederik Tovesson, LANL*
Summer Lockerbie (on detail)	
LTC Dan Mattei (Weaponization)	
James Peltz (on detail)	
Chris Ramos (Safeguards and Remote Detection)	

Office of Nuclear Detonation Detection
Thomas Kiess, Director
Angela Rachlin, CTR

Program Managers	Technical Advisors
Leslie Casey (Ground-based Nuclear Detonation Detection)	*Brian Dougherty, LANL*
Maj Alan Louie (Space-based Nuclear Detonation Detection)	*Scott Jones, SNL*
Vaughn Standley (on detail)	*Greg Schaaff, Y-12*
Donna Wilt (Forensics)	*Megan Slinkard, SNL*
	Mark Sullivan, CTR

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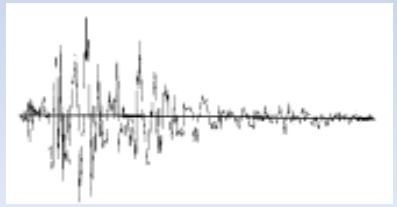
Office of Nuclear Detonation Detection (NDD)



Nuclear Detonation?
(e.g., test or illicit act)

Space-based Nuclear Detonation Detection

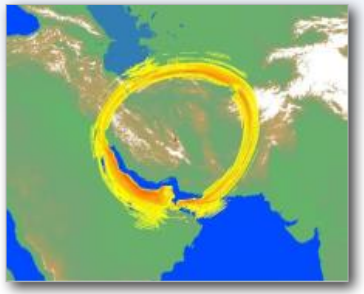
- Near real-time identification via signals at long range
- Sensors build capability of U.S. Nuclear Detonation (NuDet) Detection System (USNDS)

Nuclear Forensics Program

- Characterize Events to Answer Questions re Origin & Provenance
- Scenarios include near-surface low-yield urban detonations
- Local access to signals/samples

Ground-Based Nuclear Detonation Detection

- Detect signals at global, regional, and local distances
- Geophysical and radionuclide technologies relevant to U.S. Nuclear Data Center & US Atomic Energy Detection System (USAEDS)



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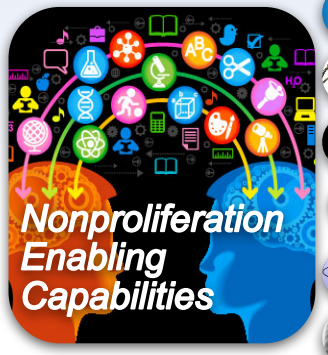
Office of Proliferation Detection

Mission:

Advance U.S. capabilities for global detection of nuclear weapons development activities, including material production, movement, weaponization, and the characterization of nuclear explosions.

- *Uranium Production Detection*
- *Plutonium Production Detection*
- *International Safeguards*
- *Other Nuclear Processes*

- *Weapons Development Detection*
- *Emergency Response*
- *Nuclear Test Detection*



- *Innovation*
- *Near-field Detection*
- *Remote Detection*
- *Data Science*
- *Signature Physics*
- *Radiological Source Replacement*

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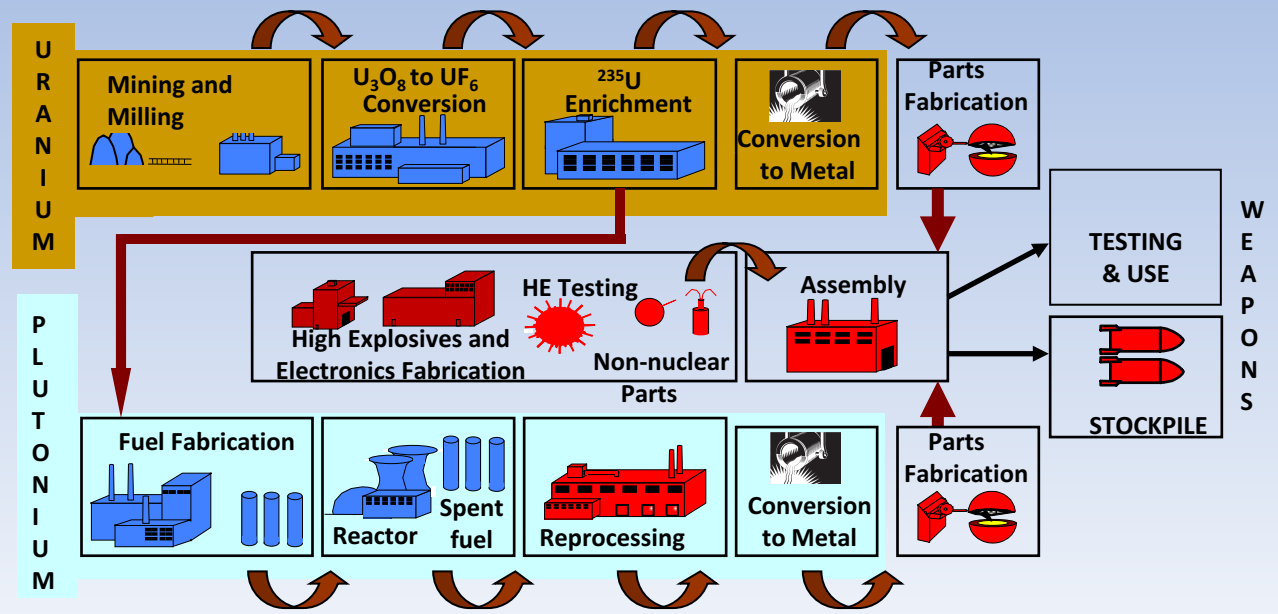
Research Objectives
Nuclear Material Production Detection and Monitoring

U-235 Production Detection

Signature detection; facility characterization; EM; Conversion; Enrichment

Pu Production Detection

Reactor monitoring; reprocessing; zeolites/MOF; Moran Solvent Test Bed; Metal Production



International Safeguards

Tags and Seals; Improving nuclear measurements; improving inspector efficiency

Advances U.S. technical capabilities to detect, characterize, and monitor the foreign production of special nuclear materials

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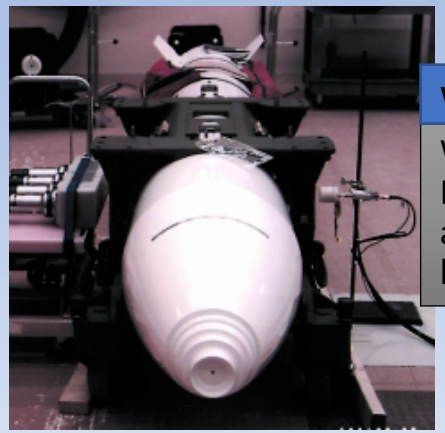
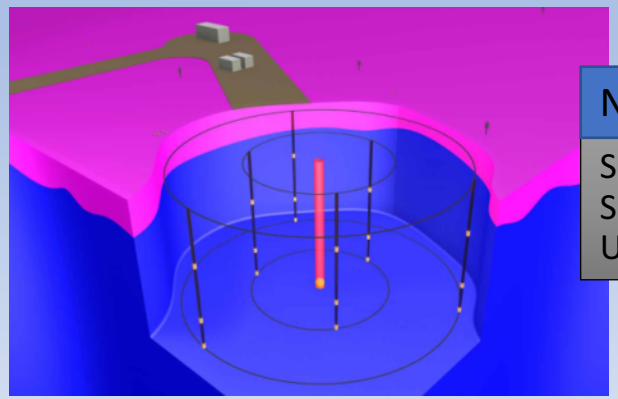
Research Objectives
Weapons Development Detection and Security



Warhead Verification & Monitoring

Warhead Measurement Campaign; End to End Demonstration; Warhead confirmation and dismantlement methods; Information barriers



Nuclear Test Detection

Source Physics; Sensors; Local Sensing; Signal Analysis; Signal Propagation; UNESE; LYNM

Emergency Response

RN Search Demonstration; 3D and directional GADRAS; Device Diagnostics; Threat Science R&D

Weaponization Detection

Source term extension; Machine metal shaping; Acoustics; EM; Hydrotest

Advances U.S. technical capabilities in support of nuclear counter terrorism and incident response and to detect, characterize, and monitor the foreign development of nuclear weapons.

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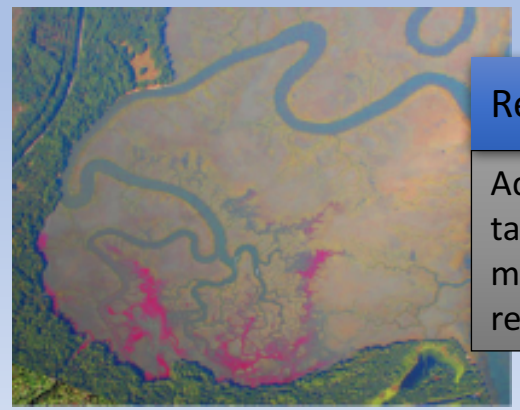
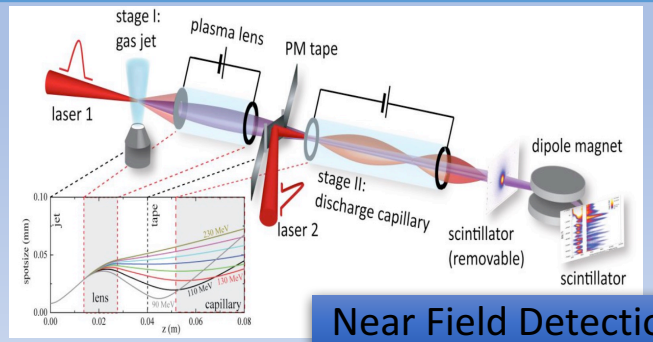
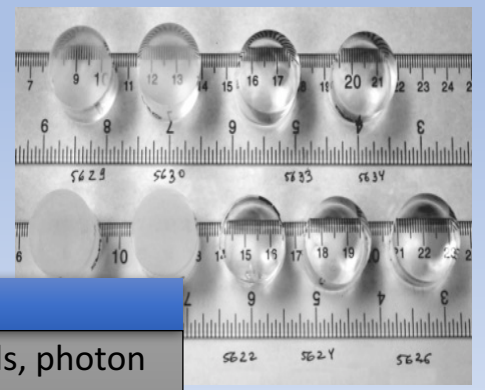
Research Objectives
Enabling and Cross Cutting Technologies



Remote Detection

Advanced capabilities to target activities and materials of interest remotely



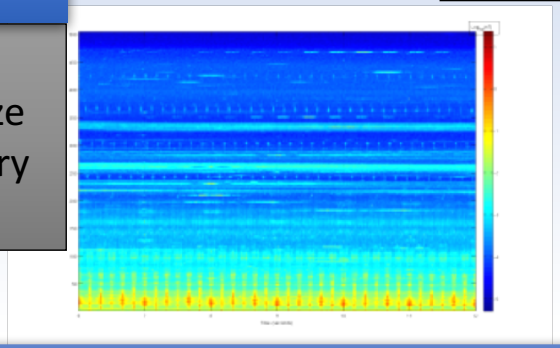


Near Field Detection

Radiation detection materials, photon & neutron detectors, room temperature semi-conductors, 3He replacements; photon sources, neutron sources

Data Science & Signature Physics

Novel methodologies and techniques to explore and analyze data to enable signature discovery across the PD mission space



Innovation Portfolio

"Risky", potentially high-payoff projects

Develops innovative, and cross-mission technologies, methods and tools.

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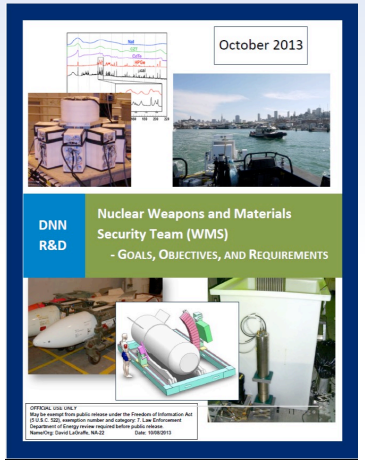
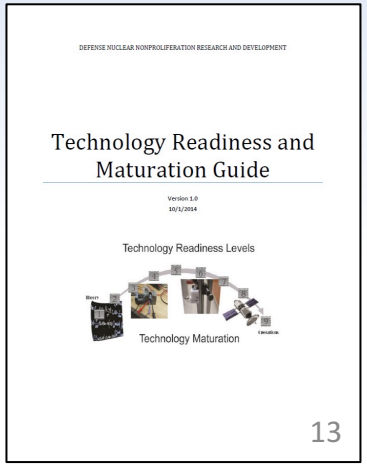
R&D Management

- Principles
  - Technical merit review
  - Stakeholder input throughout the R&D cycle
  - Progress measured via TRL assessment
  - Independent assessment
  - Alignment with strategic National Laboratory planning
- ‘GOR’ Documents
- Technical Roadmaps
- 3 R&D Avenues: National Labs, Integrated University Program, SBIR/STTR





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Integrated University Program

- Joint with NRC and DOE/NE
- Purpose
  - Support basic research directly impacting nuclear nonproliferation
    - Basic research can be done more cheaply/effectively at universities
  - Bridge the nuclear nonproliferation knowledge bases in academic and DOE national laboratory system
  - Provide a source of highly trained nuclear nonproliferation technical expertise for the DOE/NNSA national laboratory system
- Consortia Model
  - Nuclear Science and Security Consortium (Lead - UC Berkeley)
  - Consortium for Verification Technology (Lead - U of Michigan)
  - Consortium for Enabling Capabilities (Lead - NC State)

Small Business Innovation Research (SBIR)
Small Business Technology Transfer (STTR)

- Congressionally mandated program
- R&D Funds 'taxed'
  - SBIR 3.2%
  - STTR 0.45%
- Administered through DOE/SC
- R&D no longer a sufficient justification for awards – commercialization pathway required
- Radiation detection current priority
- Universities can play larger role in STTR program
  - PI can be from university
  - Up to 60% of funding can go to university
- Phase I FOA released on 27 November
- https://science.energy.gov/sbir/funding-opportunities/

Future Efforts
Advanced Data Analytics for Proliferation Detection (ADAPD)

ADAPD Goals:

1. Measure the performance of new data analytics methods by applying them to data collections from DOE NNSA proliferation demonstration test beds
2. Capitalize on DOE subject matter expertise to develop predictive models that provide a context for optimal application of data analytics to proliferation detection
3. Focus data analytics R&D at the DOE national laboratories to optimize industry and academic advances for proliferation detection

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ADAPD integrates subject matter expertise within the DOE national labs to create new capabilities for analyzing growing global data streams and traditional intelligence data to enable early warning of nuclear proliferation.

Future Efforts
Nuclear Data Roadmapping and Enhancement Workshop (NDREW)

WHEN: January 23-25, 2018

WHERE: UC Washington Center, Washington, DC

WHO: Nuclear Data Community and End Users

(if interested, email timothy.ault@nnsa.doe.gov)

TOPICS: Nuclear data for nonproliferation, including fission yields, cross sections, gamma & neutron spectra, etc.

Workshop Objectives:

- Develop a nonproliferation nuclear data roadmap that identifies nuclear data gaps and prioritization
- Ensure that roadmap captures nuclear data needs broadly across NA-22 mission space
- Facilitate interagency coordination and collaboration on nuclear data
- Increase mutual awareness and understanding of different stakeholder segments of the nuclear data community, including experimentalists, evaluators, end-users and program managers

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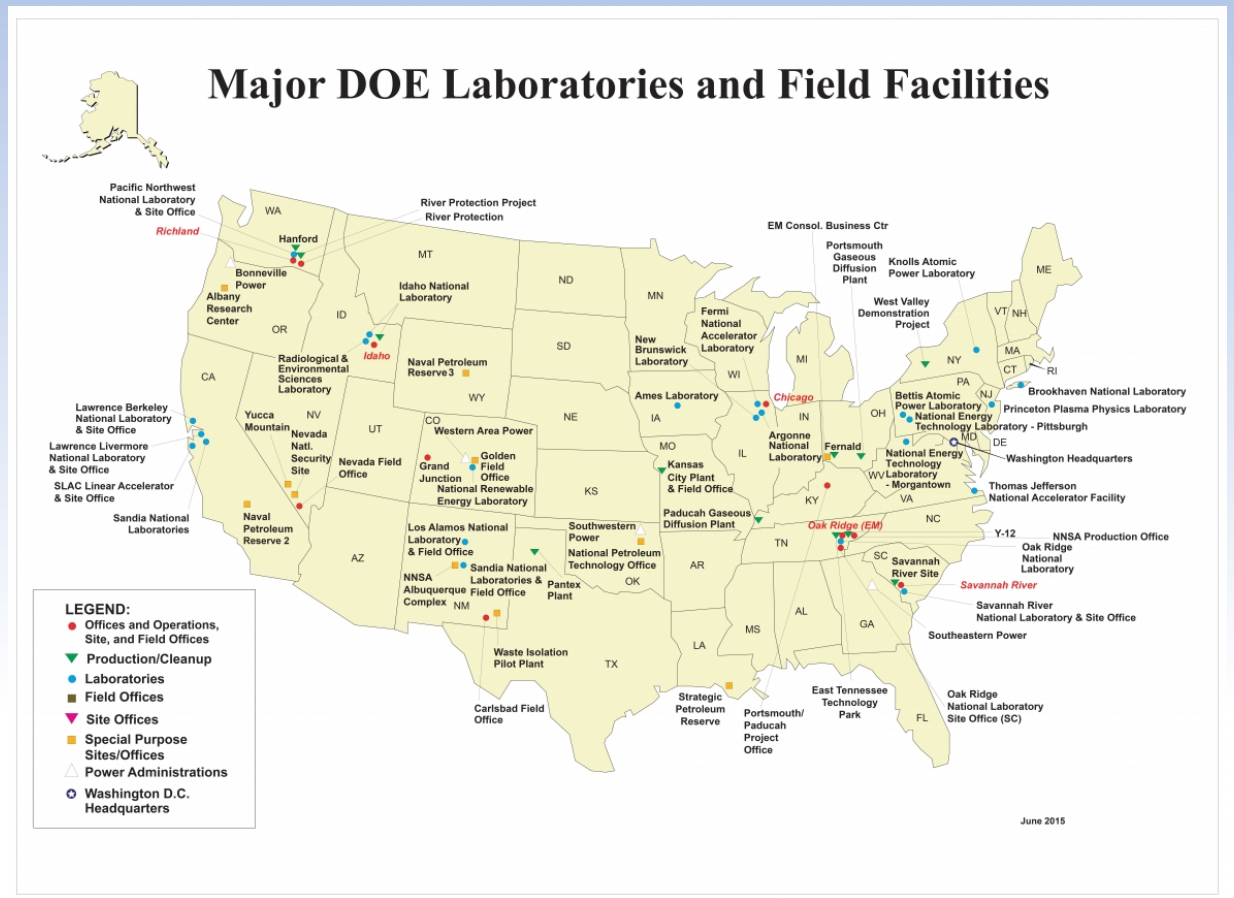
Opportunities

- The National Labs are hiring!!! (especially in national security)



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Opportunities—NNSA Graduate Fellowship Program

- Highly motivated graduate-level students and recent graduates (U.S. citizens) interested in exploring a career in nuclear security
- Fellow assignments
  - Policy focus
  - Technical focus
  - Operational focus
- Application deadline for Class of 2019-2020
  - Open around March 2018, close in October 2018
  - http://ngp.pnnl.gov
- Salary and benefits
  - Annual salary: $52,000 ($62,000 for post-doctoral Fellows)
  - $4,000 recruitment incentive
  - Health and dental plans, paid vacation and holidays, tuition reimbursement

Opportunities—NGFP

- Who is the NGFP for?
  - Those who want to contribute to a science, technology, and policy enterprise
  - Those interested in national security and public service
  - Those who want to explore alternatives to industry or academia, and gain insight into Federal career opportunities
  - Self-starters who will overlap the needs of their office with their own skills, curiosity, and interests

- What does the NGFP want to achieve?
  - Recruit and prepare our replacements – Fellows are highly sought after, and ~80% remain within the DOE/NNSA complex
  - Expose Fellows to program management, enterprise planning, international engagement, and science funding methodologies
  - Develop Fellows' professional networks and skills needed for their careers

Opportunities—NGFP Assignments

- *Travel* to DOE/NNSA national labs, plants, and sites to gain exposure to diverse programs and research portfolios
  - *Obtain* exclusive and highly-specialized training and access
- *Interface* directly with the national laboratories, the Intelligence Community, and the interagency on issues of importance to NNSA
  - Depts of Defense, State, and Homeland Security are frequent partners
- *Engage* with international organizations and partner countries on nuclear security and nonproliferation matters
  - Fellows have worked with the UN, IAEA, U.K., South Korea, Kazakhstan, Argentina, Russia, Belarus, Ukraine, and many others!
- *Contribute* to national-level planning and reporting on stockpile stewardship, nonproliferation, and counterterrorism
  - Communicate the status of our efforts to the stakeholder community, and anticipate future national and global needs
- ***Act* as a force multiplier for NNSA and be at the center of national decision making on nuclear security**

Video

Summary

- The Office of Defense Nuclear Nonproliferation R&D is the leading USG organization for the development of new technology in support of the USG's nuclear nonproliferation goals
- We view universities as a critical partner in our success
  - We want to strengthen ties among the labs, universities, and industry
- There are lots of opportunities for new graduates at the labs and within the government