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Nuclear Engineering and Nonproliferation Division

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Los Alamos National Laboratory

September 11, 2013

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ADCLES Bioscience	ADE Accelerator Operations & Technology	ADEPS Materials Physics & Applications	ADIT Departmental Computing Services	ADTSC Computer, Computational & Statistical Sciences
Chemistry	Applied Engineering & Technology	Materials Science & Technology	Network & Infrastructure Engineering	High Performance Computing
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Nuclear Component Operations	Weapons Systems Engineering	Theoretical Design
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ADTIR Defense Systems and Analysis
Intelligence, Analysis, and Technology
Intelligence and Space Research
Nuclear Engineering & Nonproliferation

Institutional Strategic Outcomes Office

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Nuclear Nonproliferation & Security

Intelligence, Defense & Counterterrorism

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Engineering & Technology	
Regulatory Management	
TA-21 Closure	
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CMRR

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DGL: Vacant

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Nuclear Engineering and Nonproliferation (NEN) Division

- *NEN works on the front lines and behind the scenes to prevent the illicit use of nuclear or radiological materials as threats to national or international security*

EOY FY12 Funding ~\$166 M

- *NEN Division and its predecessors:*
 - *pioneered nuclear safeguards concepts,*
 - *developed most of instruments and techniques used to monitor and measure nuclear materials,*
 - *operates the Nation's only capability for nuclear criticality experiments,*
 - and pioneered the development of unique nuclear reactor concepts.*

NEN Division Statistics at a glance

Personnel: 235 employees

- 46% R&D Engineers & Scientists (~ 2/3 PhDs)
- 28% Technicians and Technologists
- 16% Postdocs/ Students
- Remainder: admins, managers..

LANL: 245 staff with degrees in NE or HP

NEN: 46 NE's and 3 HP's

XCP: 25 NE's and 1 HP

Disciplines Represented: chemistry, physics, nuclear engineering, mathematics, biology, political science, mechanical engineering, electrical engineering, computer science/engineering, economics, ...

Key NEN Division Capabilities

- Radiation detection technique development and testing
- Radiography
- Active interrogation
- Treaty and agreement implementation
- Border control and detection of illicit trafficking
- Domestic and International safeguards
- Criticality experiments
- Portal monitors for people, packages, vehicles, ...
- Sensor fusion analysis
- Emergency Response nuclear diagnostics
- Nonproliferation policy analysis
- Information systems for nuclear facilities
- Fuel cycle safeguards for proliferation resistance
- Computer vision/ automated object recognition
- Hands-on training and demonstrations

Nonproliferation - Key to Global Security

Chemistry, nuclear physics, solid state physics, high energy physics, materials science, information science, statistics, mathematics, critical experiments, theoretical physics, earth science, space science, nanotechnology

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Nonproliferation Scope at LANL

Strengthen Nonproliferation Regime – Our Roles

- **WP and GS: Understanding foreign programs**
- **Strengthening of international inspections**
 - LANL has largest IAEA support program budget (~\$4M of ~\$12M).
 - LANL has trained nearly all IAEA inspectors over the past 30 years
 - NEN instruments and expertise are used for safeguards worldwide
- **Build a new framework for civil nuclear cooperation**
 - Large LANL role through DOE/NE
 - Substantial LANL involvement in policy and safeguards
- **Expanded global security engagement**
 - Bilateral nuclear security projects (e.g. Japan)
 - Remove, protect, and safeguard BN-250 materials (Kazakhstan)
 - “Centers of Excellence” for nuclear security training (China, India)

Detect and Interdict

- Responsible for certifying all Second Line of Defense (SLD) and Megaports technologies to ensure detection goals are met (LANL Test Beds)
- On-site acceptance testing to certify all international detector installations at border crossings, seaports, and airports
- Provide technical analysis and training to support SLD/MP con-ops
- Review data to advise response (Reach-back)

Future:

- Larger global engagement; complete Russia/FSU installations
- New radiation detection technologies R&D
- He3 replacement detector technologies R&D

Nuclear Rollback and Material Disposition

- **Libya** – LANL staff supported the phased characterization and withdrawal of gas centrifuge related equipment and material
- **DPRK** – developed technologies to support the IAEA verification of N. Korea's denuclearization
- **HEU blend down** – LANL designed the enrichment monitor. Over 15,000 Russian nuclear warheads have been eliminated
- **Plutonium Disposition** – LANL developed the ARIES warhead dismantling line and fabricated the lead test assemble for conversion to MOX fuel

Future:

- Continue to support DPRK 6-party negotiations and denuclearization efforts
- Developing technologies for the next steps

In pool testing of research reactor fuel counter

The spent fuel rod counter monitors reactor discharges

Gas Centrifuges removed from Libya

HEU Blend Down Monitoring System in Seversk

Nuclear Nonproliferation and Security (NNS) Sponsors

Enrichment monitor development and testing at TA-18

Spent fuel verification in the UK

■ Nonproliferation & International Security (NA-24)

- NA-241 – Dismantlement & Transparency
 - Warhead & Fissile Material Transparency
 - HEU Transparency Implementation
 - Nuclear Noncompliance Verification
- NA-242 – Global Security Engagement & Cooperation
 - International Technical Cooperation
 - Nuclear Cities Initiative
 - Initiative for Proliferation Prevention
- NA-243 – International Regimes & Agreements
 - International Safeguards
 - Nuclear Treaties & Agreements
 - Non-Nuclear Security (Chem.Bio weapons convention)

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IAEA – Department of State

- Program of Technical Assistance to IAEA Safeguards (POTAS)
- Major LANL projects:
 - IAEA safeguards inspector NDA training
 - Design, build, & install NDA equipment for Rokkasho reprocessing plant in Japan
 - Safeguards for Chernobyl spent fuel
 - UNARM computer software development
 - Open source information analysis

*IAEA safeguards
inspector school
at CMR*

*Transfer cask
at Chernobyl*

*Improved IAEA
Plutonium Canister
Assay System*

Global Threat Reduction Initiative (GTRI)

■ Global Threat Reduction (NA-21)

- Protection and disposal of radiological sources
 - U.S. - Off-Site Source Recovery (OSRP)
 - International Radiological Threat Reduction
- Kazakhstan spent fuel storage
- Russian fuel repatriation projects

■ Int'l Material Protection & Control (NA-25)

- MPC&A - civilian and weapon SNM
 - China (civilian only)
 - Tomsk,
 - Mayak MC&A,
 - Sarov, Central Storage Facility
- Second Line of Defense
 - Core Program (Russia / FSU)
 - Megaports Initiative

*Pre-Beijing
Olympics source
recovery*

Historic Beijing Tech Demo

Straddle Carrier

Nuclear Emergency Response (ER)

Nuclear Emergency Responder Training at TA-18

Traffic bollard with RDD used in drill

■ ER sponsors:

- Office of Emergency Response (NA-42) and WFO

■ Mission

- Validation of ER capabilities
- R&D: technology development, predictive research and criticality experiments
- Specialized, hands-on technical and operational training for DOD and DOJ personnel
- Operational support:
 - In-field technical support
 - Triage technical support for rapid assessments
 - Home-team support of field operations

Nuclear Counter-Terrorism (NCT)

NCT Sponsors:

- Office of Nuclear Counterterrorism (NA-47) and WFO

Mission:

- Threat Definition
 - Joint DOE/DOD training aids
- Exploring sensitive IND designs
- Training of DOD, FBI, and other responders
- Communicated Threat Assessment/NAP
- Forensics, incl. between 1st and 2nd det
- Attractiveness of nuclear fuel cycles

Radiation test object measurements at TA-18 & the DAF

National Criticality Safety Program (NA-17)

Critical & subcritical experiments are conducted to:

- **Measure fundamental physics constants (ie. cross sections)**
- **Support NW programs**
 - Actinide properties
 - Weapons safety
- **Conduct criticality safety research and training**
 - Benchmarks
 - Temperature coefficients
 - Basic and advanced training

**59.6 kg of HEU
and 6 kg of Np**

**24 kg of HEU
surrounded by steel**

**4.5 kg α -phase
plutonium sphere**

**Device Assembly Facility
(DAF)**

Department of Homeland Security (DND0)

- Secondary Reachback
- Multi-lane Portal Test Bed
- Shielded Nuclear Alarm Resolution (SNAR)
- RIID Test & Evaluation Program
- He-3 replacement
- PeakEasy

*Outdoor, hand-on
radiological search
training & classroom
gamma spectroscopy
training*

*PeakEasy spectral
analysis software
package*

NEN S&T Challenges

■ Detection

- Clandestine facilities, materials, activities, testing
- Special Nuclear Material (SNM) at a distance
- Shielded HEU and Pu in spent fuel

■ Advanced unattended or remote monitoring systems

■ Data Integration - information extraction: additional threat indicators and signatures in data-rich environments

■ Next-generation nuclear safeguards

- Advanced fuel cycle safeguards
- Large, highly-automated enrichment & reprocessing facilities that do not meet current IAEA diversion detection goals

■ Arms control and disarmament verification (e.g., information barriers for measuring classified items)

Student Opportunities

■ NEN currently has:

- 18 Undergraduate Students
- 17 Graduate Research Assistants
- 3 PostDocs
 - Numerous recent conversions to staff positions

■ Current NEN student job ads:

- IRC27073 – Postdoctoral Research Associate
- IRC27772 – Graduate Research Assistant
- IRC27712 – Undergraduate Student