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Title:	Los Alamos: A National Security Science Laboratory Providing a Safe Secure and Effective Deterrent
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Los Alamos
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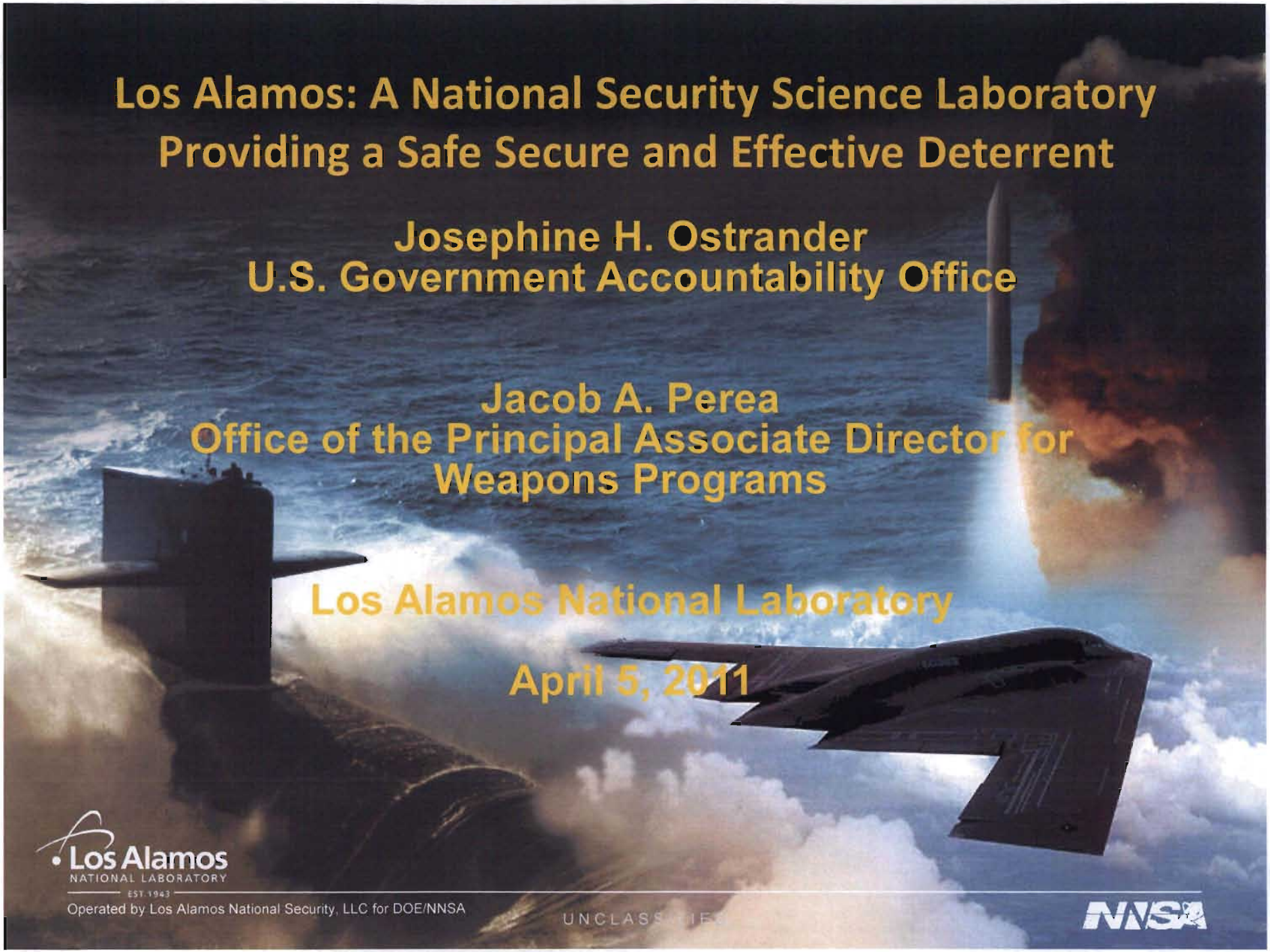
EST. 1943

Form 836 (7/06)

A credible nuclear deterrent requires a clearly articulated policy that can be sustained over many Congresses and Administrations.


Los Alamos: A National Security Science Laboratory
Providing a Safe Secure and Effective Deterrent
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Weapons Programs
Los Alamos National Laboratory
April 5, 2011
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A credible nuclear deterrent requires

- Clearly articulated policy that can be sustained over many Congresses and Administrations
- Forces in being – missiles, subs, planes, warheads & bombs
- Robust scientific and engineering complex
- Capable and responsive manufacturing complex
- Demonstrated operational capability
- Political will to deploy and ultimately use force, if necessary

World events shape U.S. national security policy and force composition

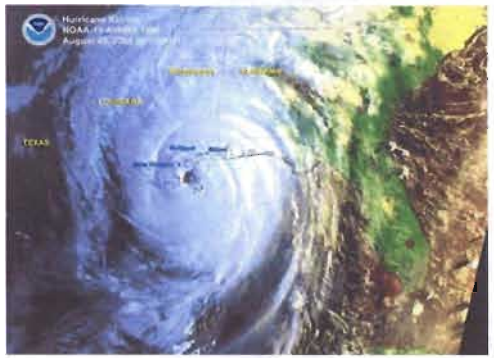
- 1945 Los Alamos tests the Trinity device (implosion)
- 1945 Los Alamos – designed Little Boy (gun) and Fat Man (implosion) bombs detonated over Hiroshima and Nagasaki, Japan
- 1949 Soviet Union conducts first nuclear test
- 1952 Los Alamos tests the MIKE device – 1st full scale thermonuclear device in Pacific; yield of 10.4 MT
- 1952 UK conducts first nuclear test
- 1960 France conducts first nuclear test
- 1962 Cuban Missile crisis
- 1964 China conducts first nuclear test
- 1968 NPT signed
- 1971 SALT I signed
- 1974 TTBT signed
- 1974 India conducts first nuclear test
- 1979 SALT II signed
- 1987 INF Treaty signed
- 1992 Soviet Union dissolves
- 1998 Pakistan conducts first nuclear test
- 2001 WTC and Pentagon attacked by Al Qaida
- 2006 North Korea conducts first nuclear test


USSR 1st test


SALT I signing

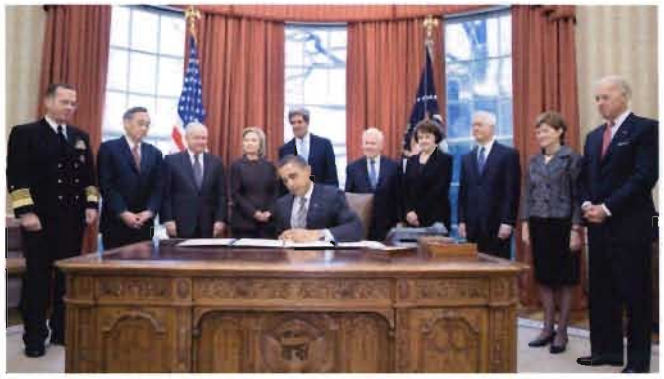
Multi-polar realities of the 21st century demand innovative approaches for U.S. national security

- Deterrence of near-peer competitors
- Nuclear proliferation
- WMD terrorism
- Assuring allies in the face of regional pressures
- Attribution of any WMD use
- Climate change and the environment
- Budget deficits and economic uncertainties



A consensus on nuclear deterrence policy for the 21st century appears to be developing

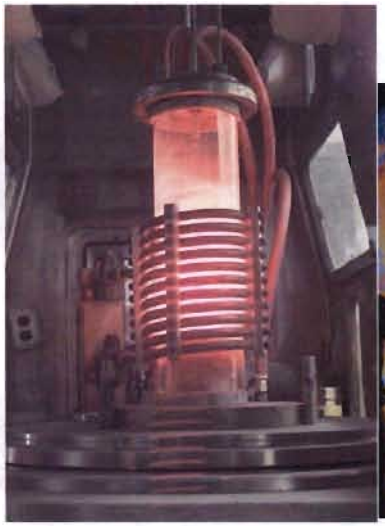
- **Safe, secure, and effective stockpile with the ultimate goal of a world free of nuclear weapons requires:**
  - Prudent management of the stockpile and LEP activities
  - Repair the nuclear infrastructure
  - Recruit and retain a workforce
- **The NPR supports 5 Presidential objectives**
  - Prevent nuclear proliferation and nuclear terrorism
  - Reduce the role of nuclear weapons
  - Maintain strategic deterrence and stability at reduced levels
  - Strengthen regional deterrence and reassurance
  - Sustain a safe, secure and effective arsenal



President Barack Obama signs the instrument of ratification of the New START Treaty in the Oval Office, Feb. 2, 2011

Policy decisions drive Laboratory planning and actions

Experiments



Actinide sciences

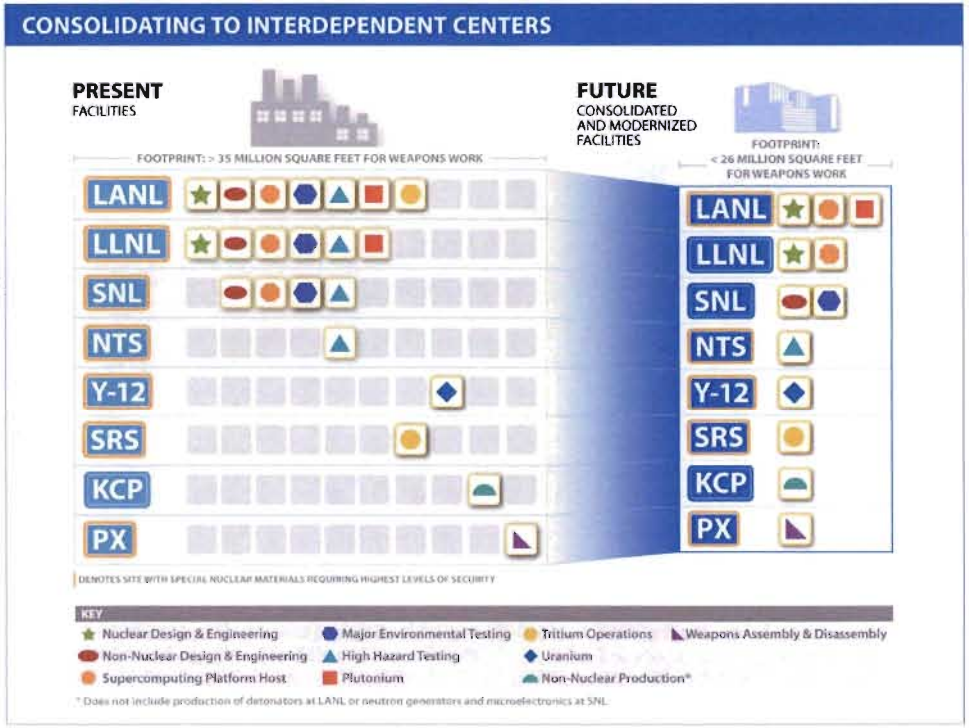
Computations and simulations

". . .as long as these weapons exist, the United States will maintain a safe, secure and effective arsenal to deter any adversary, and guarantee that defense to our allies..."

"...science holds the key to our survival as a planet and our security and prosperity as a Nation."

LANL is managing weapons responsibilities while transforming the stockpile and the nuclear enterprise

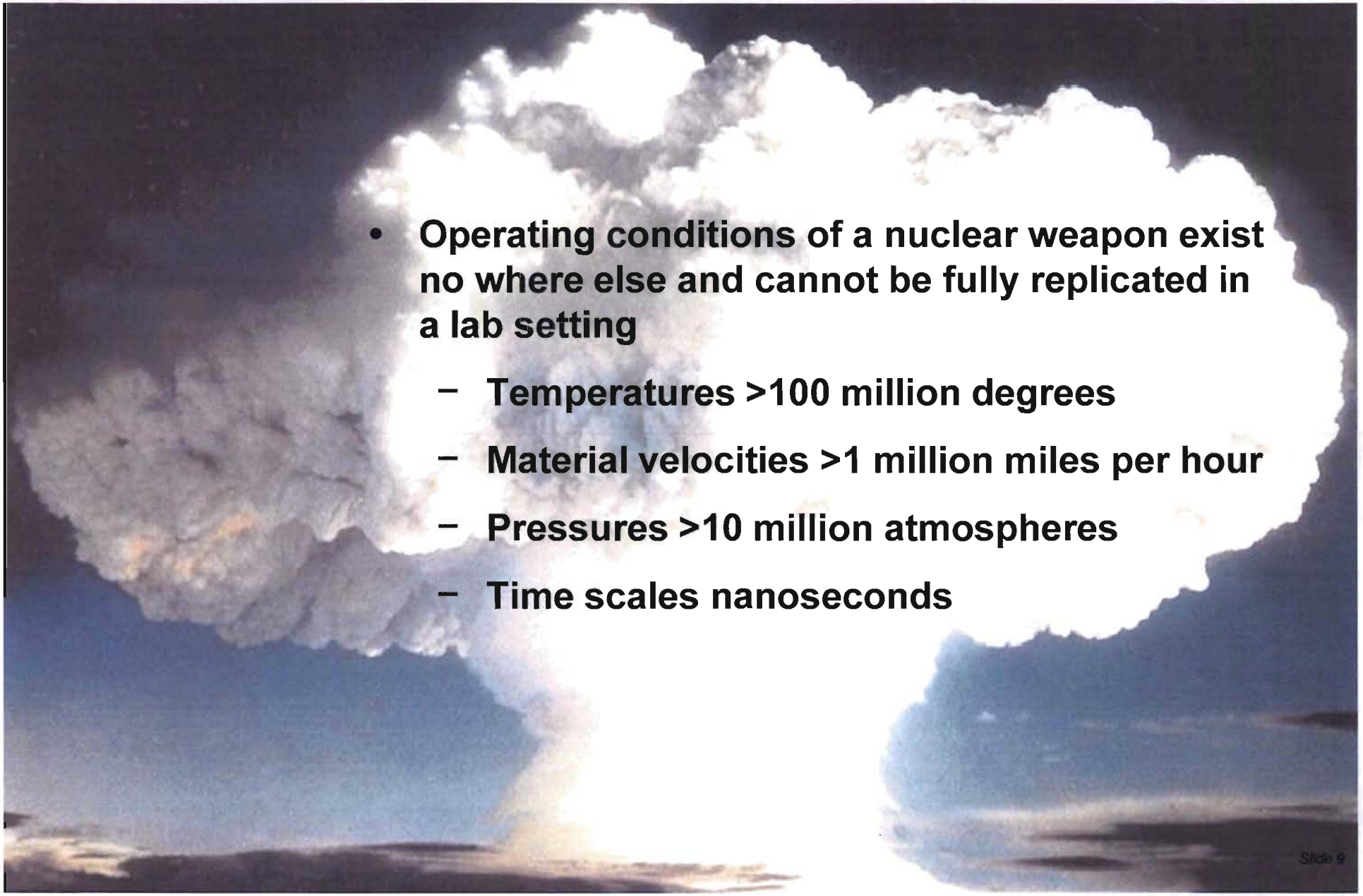
- Reduce size of nuclear arsenal – and contribute to nonproliferation
- Ensure weapons are safe, secure, and effective
- No nuclear testing
- No new military capabilities
- No new production of fissile material for weapons
- Consolidated centers of excellence
- Recapitalize the infrastructure
- Train the next generation of scientists & engineers



Weapons responsibilities require extraordinary intuition based on encyclopedic knowledge

- For mission success, we need:
  - To know the stockpile intimately (aging and evolution)
  - Robust science, engineering, and manufacturing
    - Accurate, fast, usable, reliable simulations of warheads
    - Experimental data that validate models and discover new weapons science
  - A skilled, focused, and motivated workforce
  - Facilities and infrastructure
    - That are operational and efficient
    - Supporting infrastructure and services that are responsive and cost effective

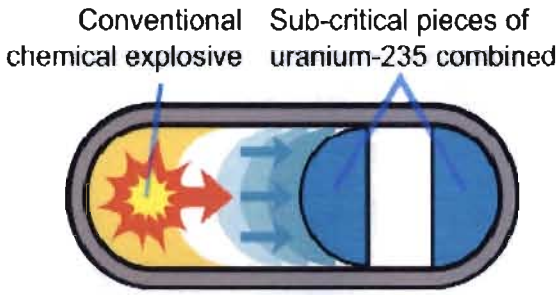
Meeting nuclear deterrent responsibilities is technically challenging because:



Scientists at Los Alamos developed two paths to the atomic bomb

- **Uranium-235 (produced by enrichment)**
  - Uranium ore (0.7% U-235, the fissile isotope, the rest is U-238)
  - Enrich uranium in U-235, typically > 90% (HEU)
    - Gas centrifuge
  - A few tens of kg required for a hypothetical bomb

    Hiroshima – Aug. 6, 1945

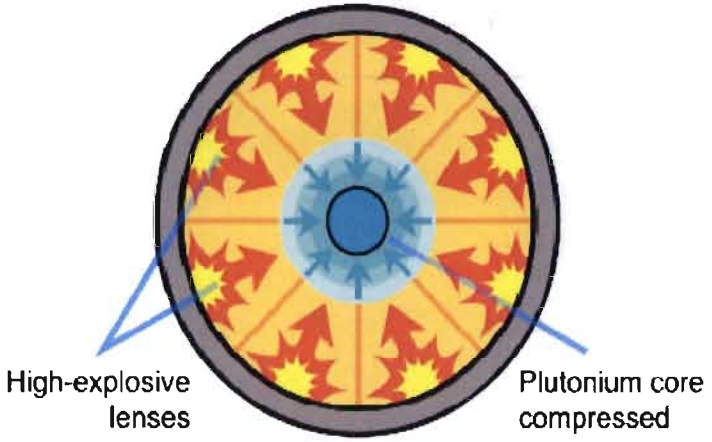


Gun-type assembly method

- **Plutonium-239 (produced in reactors)**
  - Uranium ore to fuel rods or reactor targets
  - Irradiate U-238 in reactor to make Pu-239
  - Separate (extract) Pu-239 from spent fuel
  - Pu-239 metal, typically >93% Pu-239 for bombs
  - Reactor-grade Pu (> 19% Pu-240) can be used for bombs, but is less desirable

    Trinity – July 16, 1945

    Nagasaki – Aug. 9, 1945



Implosion assembly method

LANL's three part weapons program strategy sustains the Nation's deterrent without underground testing

- Stockpile management
  - B61 Life Extension Program (LEP)
  - Support to plants on W76 LEP
  - Complete build of W88 pits begin work on W87 pits
- Science, technology and engineering investments
  - Use science tools to generate data to support assessment
- Infrastructure investments
  - Create modern, state of the art facilities to sustain laboratory capabilities
  - Hire and train next generation

LANL is the design laboratory for warheads in all legs of the of the Nation's triad

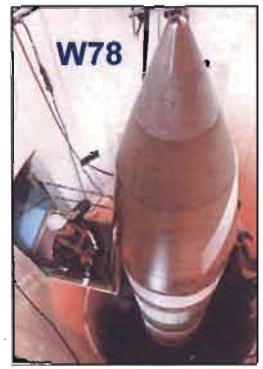
- LANL is the design laboratory for:
  - W76 SLBM
  - W88 SLBM
  - B61Gravity bomb
  - W78 ICBM
- Each Triad leg offers complimentary and reinforcing benefits

Annual Assessment of the stockpile is a statutory requirement and the highest priority of the Lab Director

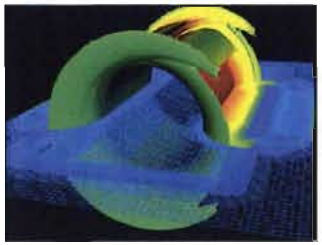
- Detailed reports are prepared by lab staff on each warhead
- Lab Director briefed in detail by staff
- Lab Director issues letter to Secretaries of Defense & Energy and Chair of the NWC
- Lab Director briefs the Secretary of Energy
- STRATCOM prepares separate report and briefs the Secretary of Defense
- Secretaries of Defense & Energy brief the President
- President advises Congress

Excellence in managing the stockpile is even more important as its size and composition are reduced


W76



- Nuclear weapons design will remain strong capability for the lab
  - Annual assessments of the stockpile
  - Accurate baselines of all warheads for certification and assessments
  - We must take action to extend the lives of systems
- Simulation will remain the principal means to certify and assess warheads, and experiments will validate and discover new physics
- Plutonium, high explosives, other weapons materials will become increasingly understood


Large-Scale Simulation

Supercomputing is essential to stewarding the stockpile and other scientific missions

- Stockpile challenges are increasingly complex as systems continue to age
- Experimental tools are providing large data sets to resolve stockpile challenges
- Data sets require ever more capable machines that can quickly process information
- Road Runner world's first machine to operate at 1.105 Petaflops

Cielo – 2nd LANL computer in top 10

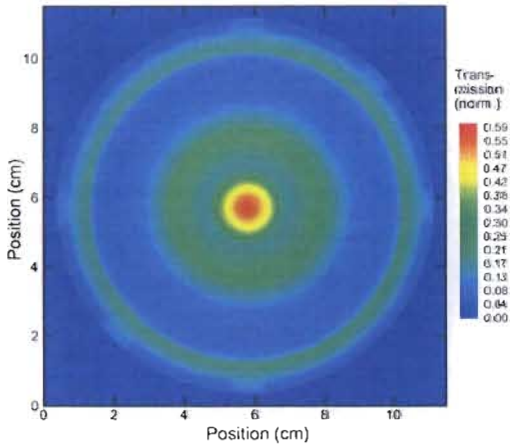
Our computing future is at exascale

- Codes accurately simulate behavior and performance of warheads across the Stockpile to Target Sequence
  - We are moving from "fitting" to physics - predictions
  - We see phenomena in simulations that we knew was there but couldn't previously resolve
- Weapons Science calculations will require exascale to explore and understand key physics and define appropriate sub-grid models for:
  - Material Science
  - Thermonuclear Burn
  - Turbulent Hydrodynamics
  - Uncertainty quantification

- Confirmatory calculations with full physics and refined resolution will be required at exascale to establish confidence in sub-grid model

Experimental data provide "ground truth" for our models and uncover important new physics

DARHT Radiograph of FTO



pRad Cu: A_0=55μm pRad Cu: A_0=35μm

- Large-scale experiments will elucidate implosion dynamics and test integrated physics models
  - DARHT and NTS will be supported and return high data rates
- Small-scale experiments will provide fundamental data (EOS, damage, strength, detonation, etc) for weapons materials and surrogates to feed theory and modeling
  - Weapons Program will support pRad, WNR, Lujan at LANSCE, which will provide needed data
  - Weapons Program will adequately support selected small-scale science facilities and future large-scale science tools such as MaRIE

Weapons baselines and predictive simulations must be validated by robust experiments

DARHT provides experimental data on the health of the deterrent

- World class X-ray radiography for hydrodynamic tests to gather data to support stockpile
- Axis 1 single image, operational since 1999
- Axis 2 up to four images
- World's first dual axis experiment successfully executed December 2009
- Experiments fully contained to reduce environmental impacts and increase shot rate

Our plutonium strategy will ensure we lead this important science for the nation

- Reinvigorate Pu science and engineering
- Pu science as a sustainable and desirable field of study
- Success and priority for actinide science
- Manufacturing and actinide R&D share a symbiotic relationship at TA-55
- Certification of new pit types conducted in reasonable time frame ($\leq$ 5 years)
- Provide intellectually stimulating work while sustaining core capabilities
- Reduce operational difficulties of working with Plutonium

LANL experimental infrastructure is supported to ensure robust operations and high weapons science data output

- DARHT
  - Adequate RTBF, equipment, skilled workforce
- HE firing sites / HE chemistry, formulation
  - Adequate RTBF, equipment, skilled workforce
  - EMCF with interim investments in TA-9-21
- LANSCE: pRad, WNR, Lujan
  - Adequate RTBF, equipment, skilled workforce
  - LANSCE-R supported by Weapons Program
- MaRIE
  - Partnership between DP and Ofc of Science
  - Advance construction project

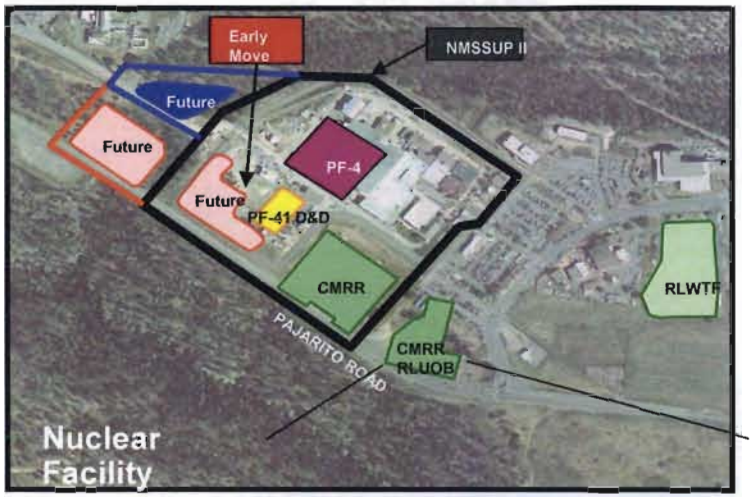
DARHT

Chamber 8 10kg firing vessel

LANSCE

LANL is implementing transformation plans: consolidation, modernization, D&D

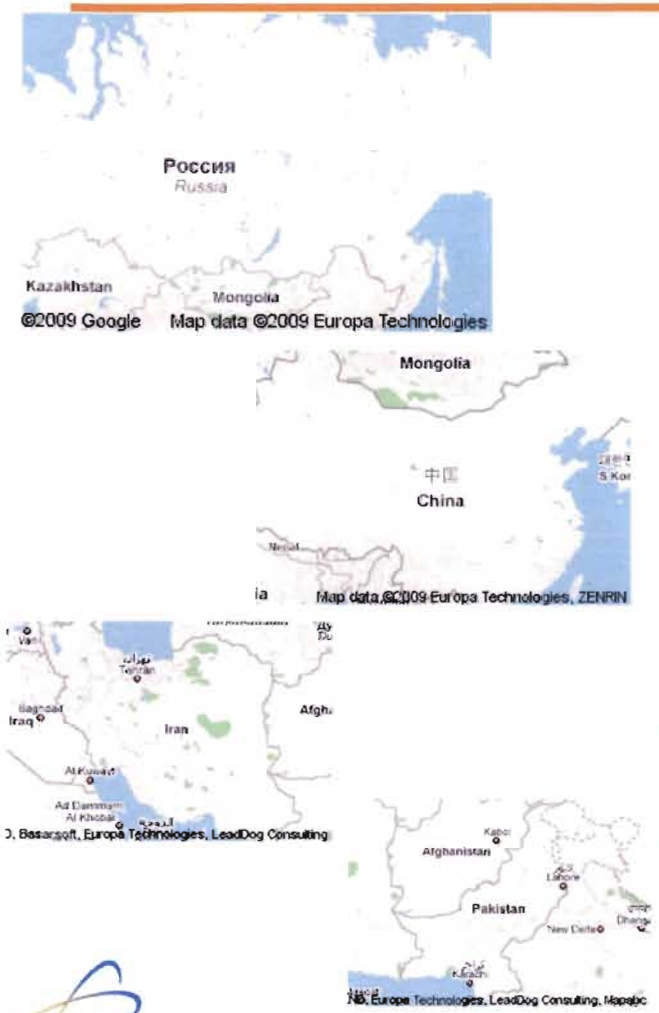
- Nuclear Facilities Consolidation by end of next decade, given adequate budget
  - CMRR
  - RLWTF
  - TA-55 Re-investment
  - TRU waste
- Non-nuclear facility consolidation
  - Contained Firing
  - EMCF
- Construction integration/support requirements
- FIRP, and hopefully its follow-on, will address deferred maintenance and D&D



Maintaining CMRR project momentum is critical to ensure project success

- Currently working with NNSA to identify and implement significant project cost saving opportunities
- Phased approach to construction
  - Infrastructure Package (Site work and lay-down areas) to initiate in FY12
  - Nuclear Facility Structure and Major Equipment items to initiate in FY13
- Continued partnership with UPF in project execution and risk mitigation
- Stable funding required through the FYNSP Period

Weapons capabilities will be needed to address external threats and to maintain technological advantage



- Key adversaries are:
  - Modernizing their stockpile
  - Training new cadre of nuclear weapons workers
  - Re-capitalizing their nuclear weapons enterprise
  - Maintaining their nuclear test readiness
- DPRK and Iran increasing their capabilities in nuclear weapons
- India and Pakistan eyeing each other suspiciously
- Non-state actors trying to acquire nuclear weapons or build improvised nuclear devices

LANL's HE science capabilities are being applied to the IED problem

- LANL's HE expertise in the areas of:
  - Homemade explosives - explosives chemists
  - Improvised explosive devices - using HMEs in IED's or EFP's
  - Small scale testing - safety and sensitivity
  - Detection - properly identifying HMEs
  - HME database - information tool for our troops

Realistic training scenarios reinforce class room knowledge to troops

Stockpile Stewardship is the core mission of Los Alamos and builds on decades of scientific excellence

- Lab's tools also address other national priorities
- Technologies to reduce national security threats
- Solutions to challenges of energy security

December 2009 Meeting with the Vice President

"A vibrant science, technology and engineering enterprise is essential to supporting the stewardship program and provides a powerful resource for issues such as nonproliferation, counter-terrorism and intelligence assessment."
DIR Anastasio 7/15/10 SASC

Los Alamos had a great year! Continue to partner across the complex to execute the Weapons Program

Key accomplishments

- Conducted 4 DARHT 2-axis experiments
- Delivered 2 key diagnostics (Gamma Reaction History, neutron imaging) to NIF
- Conducted Bacchus, Barolo A&B, and Z pinch
- Cielo delivering on applications from all 3 labs at 9X performance improvement
- Achieved Roadrunner success on weapons issues
- Completed B61LEP 90 day study
- Initiated B61 Phase 6.2/6.2a
- Completed 28 of 29 W88 pit builds
- Advise & support plants to sustain W76-1 builds
- Align CMRR requirements with risk, cost
- Delivered Q1 surveillance results
- Completed 15th annual assessment
- Identified $20M RTBF funds for LANSCE LINAC Risk Reduction (FY12+)
- Selective hiring underway

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Challenges for the future

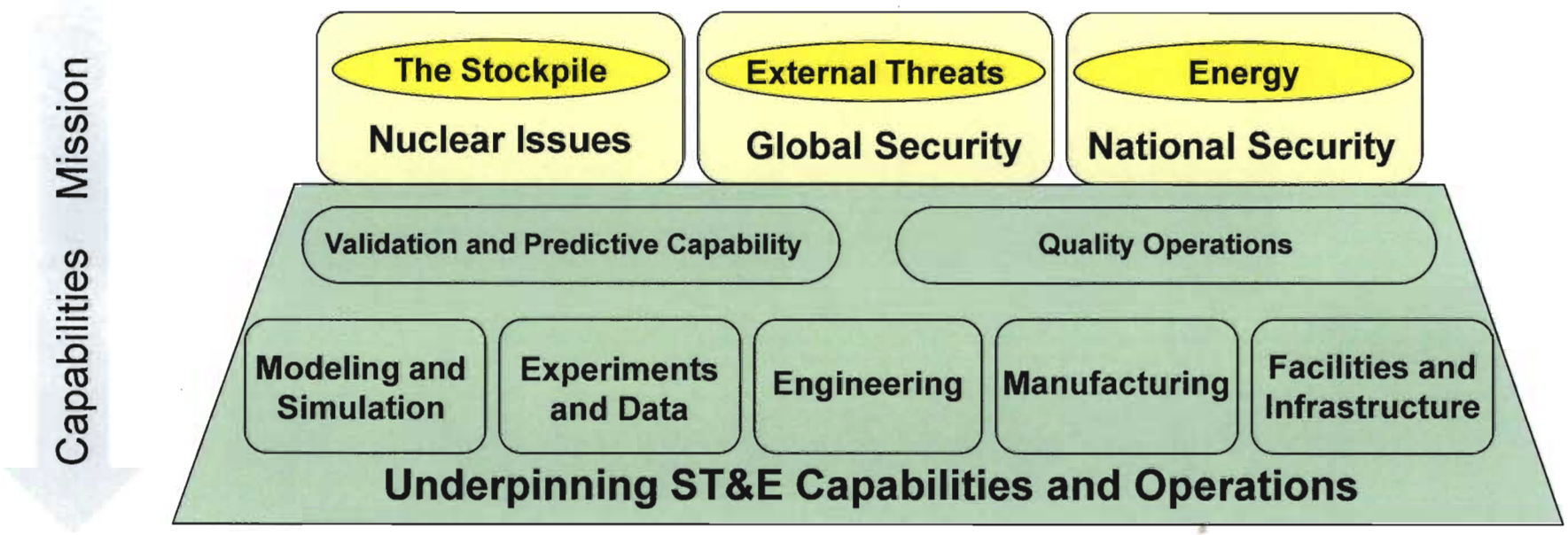
- Sustaining bipartisan consensus nuclear policy
- Squeeze on science
- Recapitalization of the infrastructure and maintaining the people pipeline

Backups

Los Alamos has contributed to the Nation's deterrent posture for more than 65 years

- 1943 Los Alamos established as part of the Manhattan project
- 1945 Trinity device (implosion) tested in New Mexico
- 1945 Little Boy (gun) and Fat Man (implosion) detonated over Hiroshima and Nagasaki, Japan
- 1952 MIKE test–1st full scale thermonuclear device tested in Pacific yield of 10.4 MT
- 1989 LANSCE proton radiography facility dedicated
- 1989 U.S. halts the design and manufacture of nuclear weapons
- 1992 U.S. conducts last underground nuclear weapons test
- 1994 Stockpile Stewardship Program established to ensure the safety, security and reliability of the stockpile w/o UGT
- 1998 New supercomputer (Blue Mtn @ 3 teraOPS) operational
- 1999 DARHT experimental machine phase 1 operational
- 2002 New supercomputer (Q machine@ 30 teraOPS) operational
- 2007 1st LANL manufactured pit delivered
- 2008 Road Runner world's 1st supercomputer to achieve 1 petaFlop operations
- 2009 Full DARHT capability online

We will meet our national security responsibilities with world class science, workforce, and facilities



"As long as these weapons exist, the United States will maintain a safe, secure, and effective arsenal to deter any adversary, and guarantee that defense to our allies…"

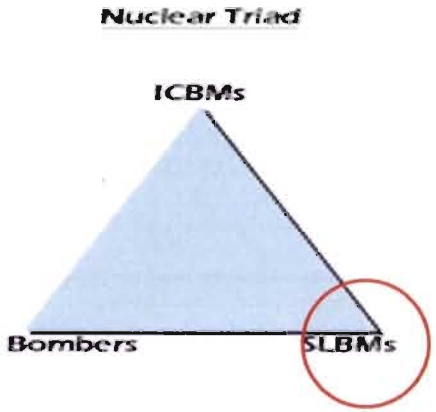
President Barack Obama, Prague, April 5, 2009

Sea leg of the TRIAD offers greatest survivability

SLBMs

- W76 (LEP underway) W88
- Highly compact for submarine deployment
- Highly optimized yield/weight to extend range
- Kings Bay, Georgia
- Bangor, Washington

W76/Mk4a RBs on maintenance stands



ICBM leg provides prompt, highly accurate response

W78/Mk12a RVs on a "bus"

ICBMs

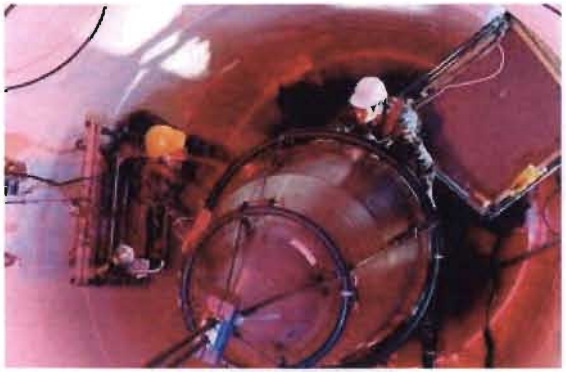
W78 LEP underway
W87 LEP complete

Ease of maintenance at remote sites

surety, compact delivery systems, robust performance

Optimized yield/weight

MIRVed - multiple reentry vehicles/missile



Minuteman III

W87/Mk21 RVs

Air Carried systems provide time for decision makers


B61-11 loading

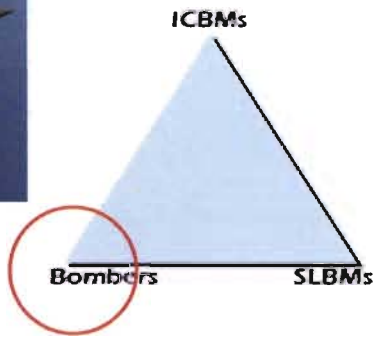
Gravity Weapons

- B61 Gravity Bomb LEP underway
- B83 Gravity Bomb

enhanced surety features
extended STS environment
compatibility
IHE, PALs


F-16 fighter


B-2 bomber




B83 Gravity Bomb

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Scientific and engineering capabilities of LANL are being applied to counter proliferation activities

- **Nuclear monitoring** nuclear monitoring and physical security systems are being developed to reduce the threat of global nuclear proliferation
- **IAEA inspectors: trained *every*** IAEA inspector since 1980

LANL's science and engineering infrastructure a critical component of U.S. deterrent

Metropolis Center for Modeling & Simulation

High Explosive laboratories

Los Alamos Neutron Science Center

Plutonium Processing Facility

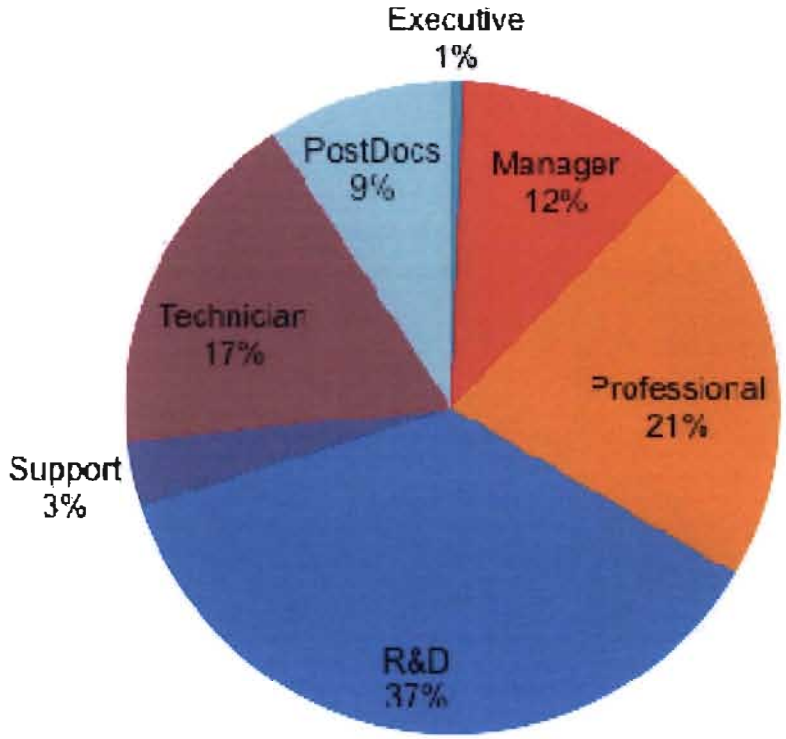
Chemistry and Metallurgy Building

Dual Axis Radiographic Hydrotest Facility

SIGMA Building

Chemistry & Metallurgy Research Replacement (RLUOB)

Prudent management of new hire process has allowed weapons program to add technical staff



PADWP Workforce breakout 1434 employees on board as of 2/11

- Staffing increases in PADWP 1/10 to 2/11
  - Professional + 25;
  - R&D +27;
  - Students/PostDoc +14;
  - Technicians +7

86 new hires approved by DIR for weapons and plutonium ADs in 2011