LA-UR-23-31557

Approved for public release; distribution is unlimited.

Title:	An Introduction to Los Alamos National Laboratory
Author(s):	Peterson, Paul David Clarke, Steven Anderson
Intended for:	Recruiting - Information Session at BYU-I
Issued:	2023-10-09

Los Alamos
NATIONAL LABORATORY

Los Alamos NATIONAL LABORATORY

An Introduction to Los Alamos National Laboratory

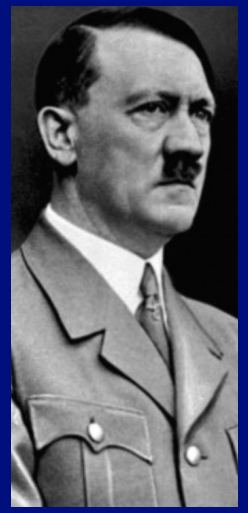
Steven A. Clarke, PhD.
Principle Scientist
Detonator Science and Technology

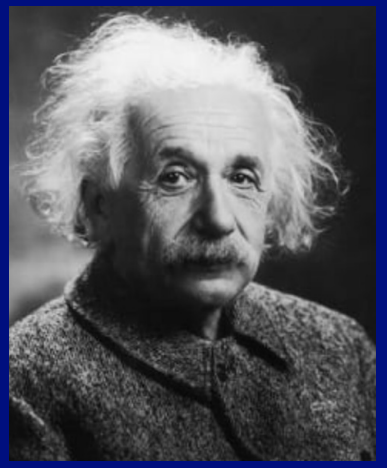
Paul D. Peterson, PhD.
Program Director
Nuclear Explosives Safety

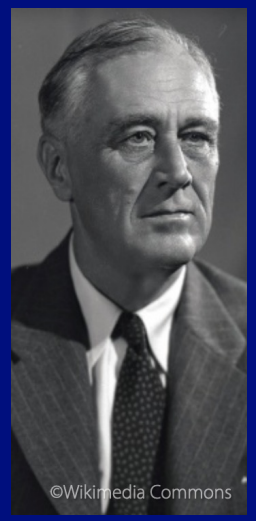
October 11-12, 2023

Just a little history. . . .

- September 30, 1938 Germany annexes part of Czechoslovakia (Munich Pact with England, France, and Italy).
- August 2, 1939, Albert Einstein writes a letter to Pres. Franklin Roosevelt (see below).
- September 1, 1939, Germany invades Poland. England and France then declare war on Germany.







Albert Einstein
Old Grove Rd.
Nassau Point
Peconic, Long Island

August 2nd, 1939

F.D. Roosevelt,
President of the United States,

The United States has only very poor ores of uranium in moderate quantities. There is some good ore in Canada and the former Czechoslovakia, while the most important source of uranium is Belgian Congo.

In view of this situation you may think it desirable to have some

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizsäcker, is attached to the Kaiser-Wilhelm-Institut in Berlin where some of the American work on uranium is now being repeated.

Yours very truly,

A. Einstein

(Albert Einstein)

the whole port together with some of the surrounding territory. However, such bombs might very well prove to be too heavy for transportation by air.

American work on uranium is now being repeated.

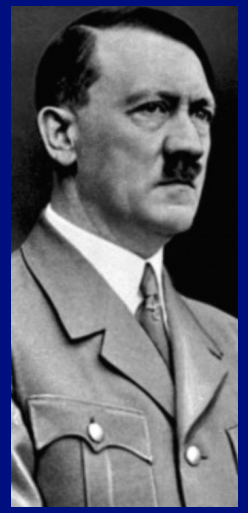
Yours very truly,

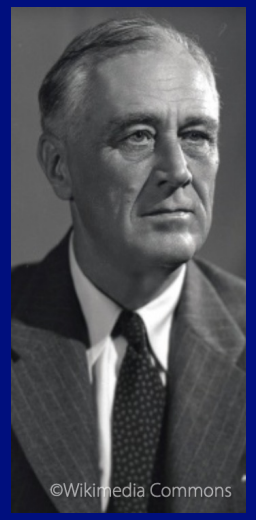
A. Einstein

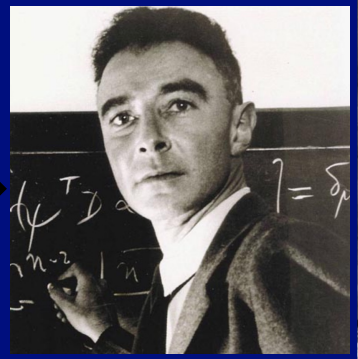
(Albert Einstein)

Just a little history. . . .

- December 7, 1941 – Japan attacks Pearl Harbor, drawing the United States into World War II
- In August 1942, General Leslie Groves and physicist Robert Oppenheimer are assigned a Top Secret Project to create a atomic bomb. Oppenheimer travels to several sites in Utah, Nevada, and New Mexico, eventually settling on a school for troubled boys in Los Alamos, New Mexico as the site for what was code-named the Manhattan Project.

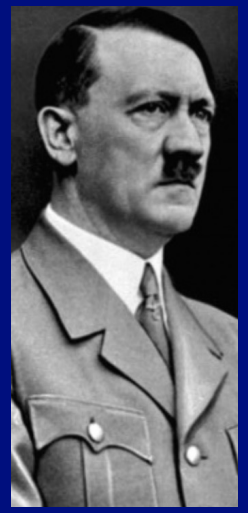


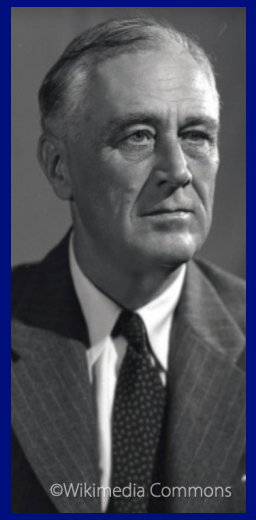


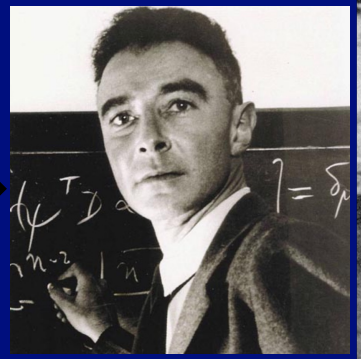


Just a little history. . . .

- January 1943 – Many of the leading U.S. Physicists, Chemists, and Engineers are recruited by the government and told to report to P.O. Box 1663, Santa Fe, NM. From there, they disappeared into the Jemez Mountains west of Santa Fe.
- Three different nuclear bomb designs were investigated – ~~Thin Man~~, **Little Boy**, and **Fat Man**.

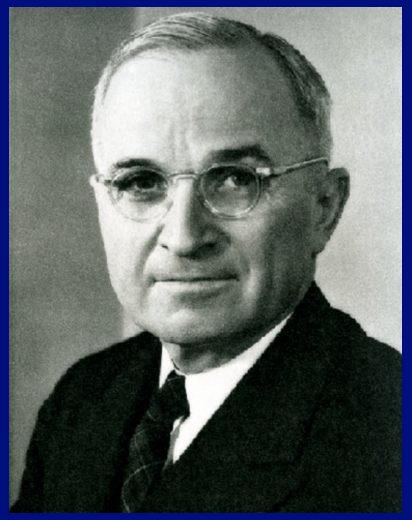




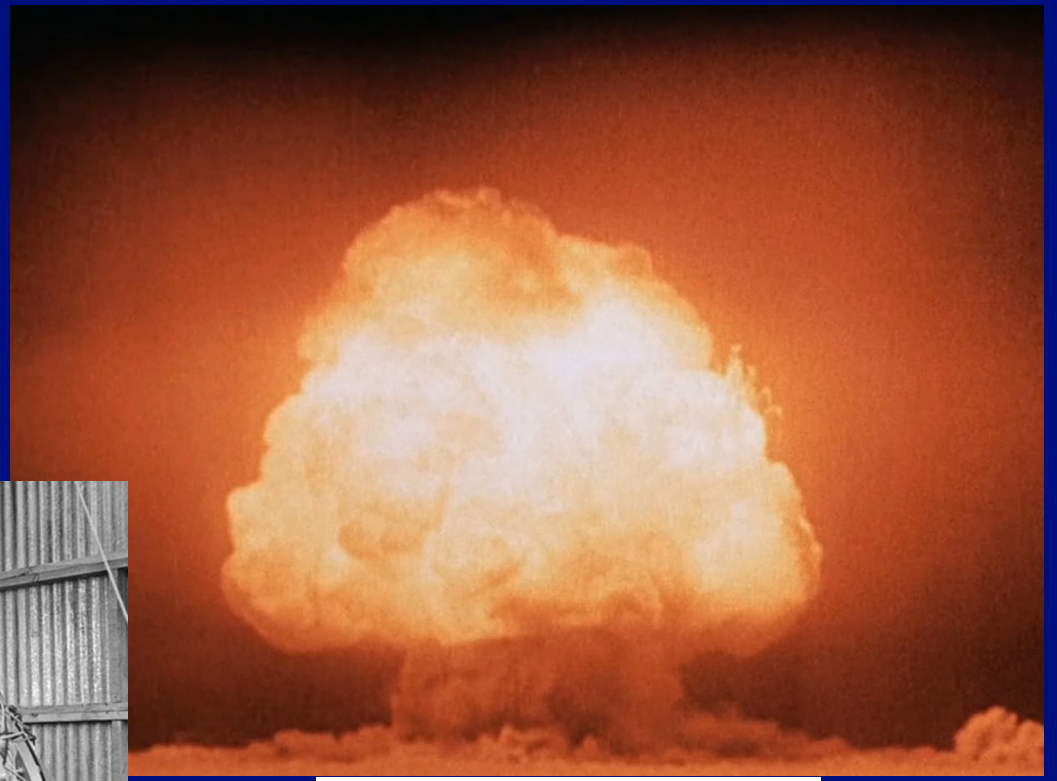


Just a little history. . . .

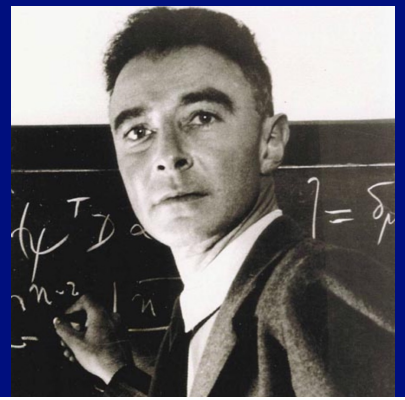
- April 12, 1945 – Roosevelt dies, Truman is sworn in as President and briefed about the of Manhattan Project for the first time.
- April 30, 1945 – Hitler is dead.
- May 8 1945 – VE Day
- July 16, 1945 – Trinity Test



The Gadget



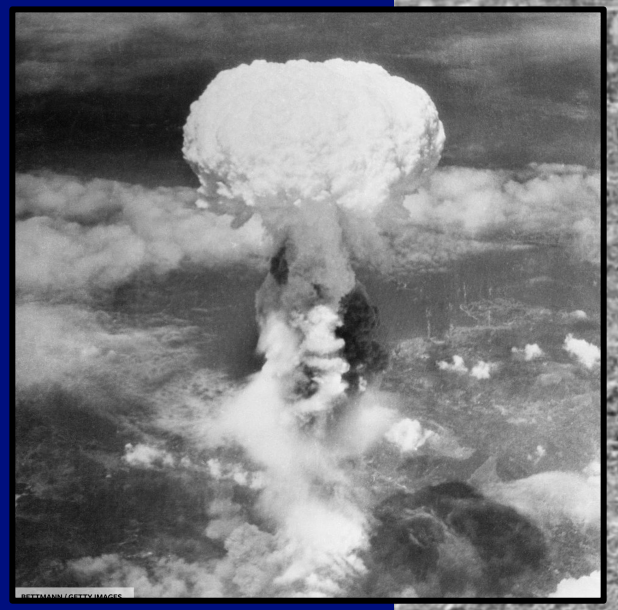
Trinity Test, July 16, 1945



"I have become death, the destroyer of worlds."

Just a little history. . . .

August 6, 1945 – Hiroshima
August 9, 1945 – Nagasaki
August 15, 1945 – VJ Day



A study done for Secretary of War Henry Stimson's staff by William Shockley estimated that invading Japan would cost **400,000 to 800,000 Allied fatalities**, and **5,000,000 to 10,000,000 Japanese fatalities.**

It's estimated that a total of **100,000 - 210,000 people** died in Hiroshima and Nagasaki either immediately or due to after effects such as radiation poisoning.

Manhattan Project faced MANY Challenges …
And we still need YOU to tackle them today!

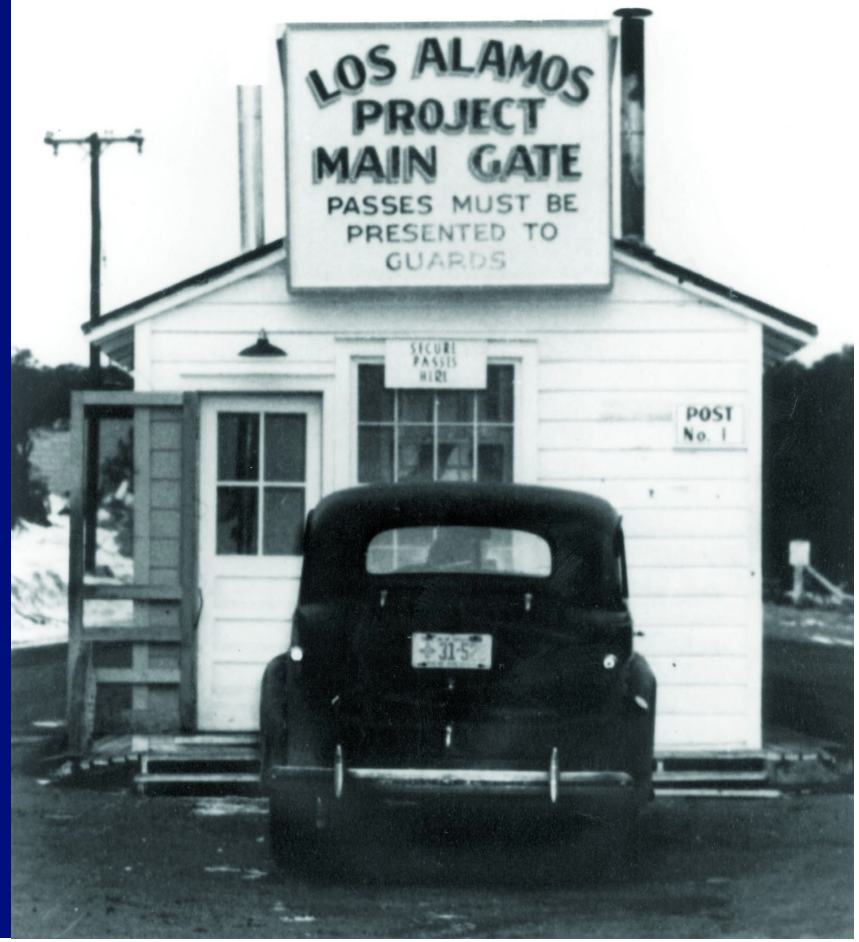
- The Physics of the Atomic Bomb was worked out in days to weeks at the beginning of the Manhattan Project
- The ENGINEERING of the Atomic Bomb represented the majority of the challenges to successful development
- Mechanical Engineering
  - How do you build this? How do design all the new components?
- Chemistry
  - Explosives, Explosive Lenses,
- Electrical Engineering
  - Fireset to control multiple firing points, diagnostics, Fuzing
- Material Science
  - new materials like Plutonium, Enriched Uranium

Some Videos

- Our Mission
  - https://www.youtube.com/watch?v=fmP-ymRhI9U
- DARHT
  - https://www.youtube.com/watch?v=FOCJCsC8gl4
- Our Science
  - https://www.youtube.com/watch?v=55hlnlVuTpk
- A common goal
  - https://www.youtube.com/watch?v=g_QOV3UAjuk
- Our Lab
  - https://www.youtube.com/watch?v=TYkSeQDfcg0

75+ years serving the nation

- Los Alamos National Laboratory (LANL) was founded in 1943 to design and build a weapon that would help end World War II
- Today, LANL focuses on maintaining a strategic nuclear deterrent to protect the nation's security
- Our workers, facilities, and instruments:
  - Design, produce, and certify current and future nuclear weapons
  - Detect nuclear weapons and improvised devices
  - Promote cooperation and diplomacy
  - Limit nuclear arms and the spread of nuclear materials, technology, and expertise



LANL is part of a large enterprise under the DOE and NNSA

- Department of Energy (DOE): Addresses energy, environmental, and nuclear challenges through science and technology solutions.
- National Nuclear Security Administration (NNSA): Enhances national security through the military application of nuclear science.
- Department of Defense (DOD): Provides military forces to deter war and ensure national security. The DOD and NNSA share responsibility for nuclear weapons.

Map of the U.S. Nuclear Security Enterprise Facilities

Lawrence Livermore National Laboratory

Forrestal Bldg in Washington DC (DOE & NNSA HQ)

Y-12 National Security Complex

Nevada National Security Site

Kansas City National Security Campus

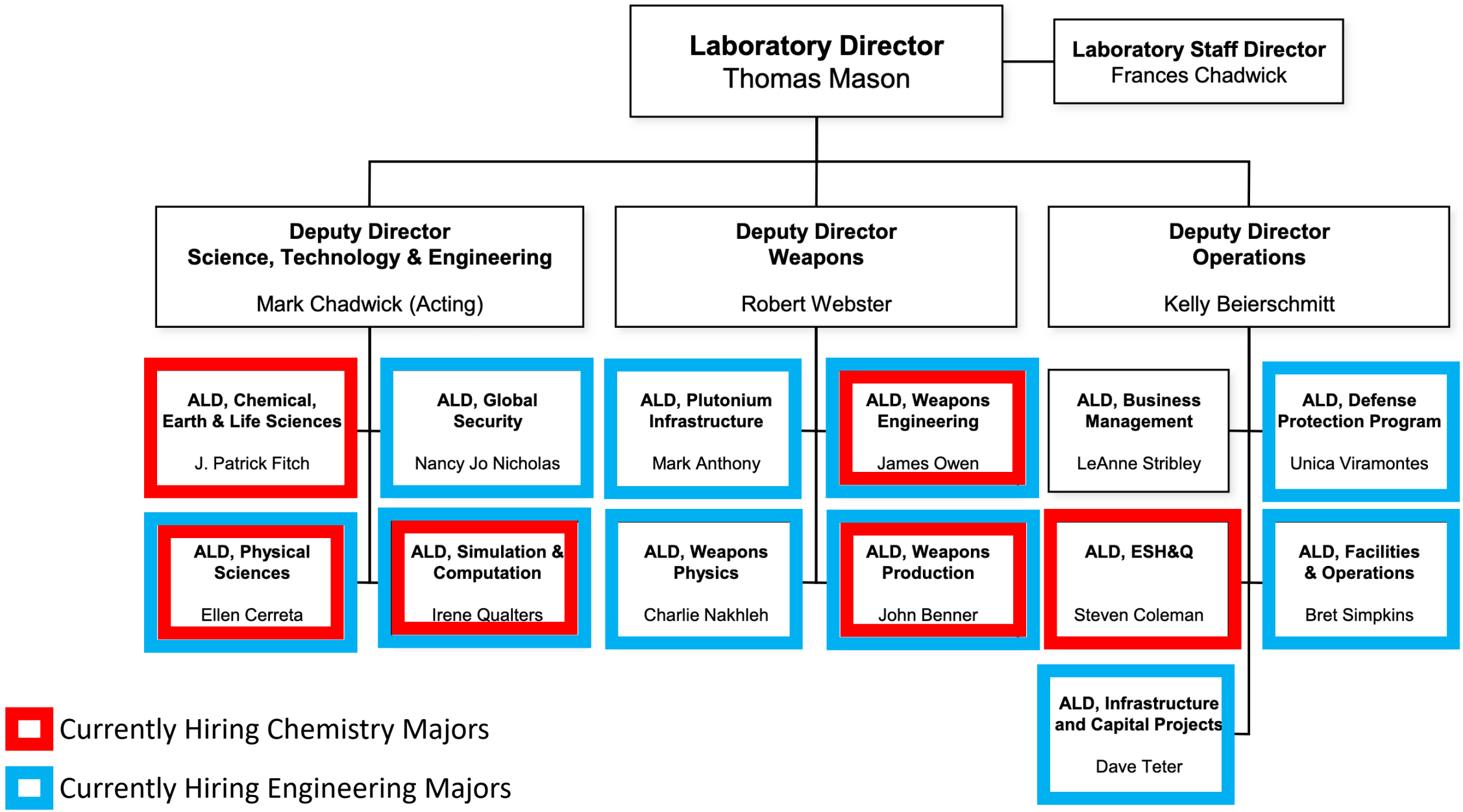
Los Alamos National Laboratory*

Sandia National Laboratories*

Pantex Plant

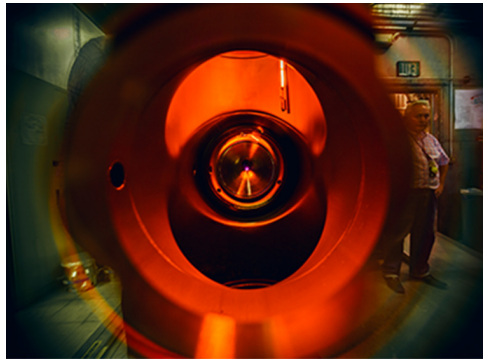
Savannah River Site

Los Alamos National Laboratory



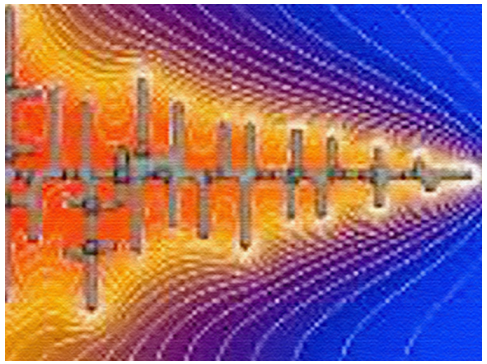
Associate Laboratory Directorate – Physical Sciences (ALDPS)

Accelerator Operations and Technology (AOT)



Underpinning LANL's accelerator capability and driving a wide range of LANL mission-relevant work

Materials Science and Technology (MST)

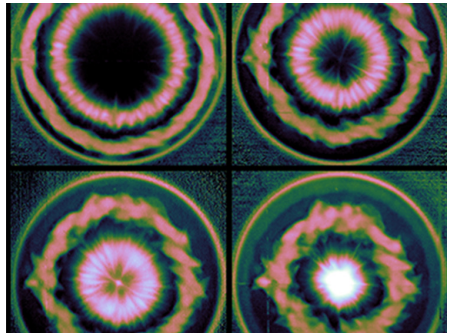


Emphasizing materials synthesis, processing, properties, and performance through an integrated suite of deliverables from component manufacturing to fundamental materials science

LANSCE Facility Operations (LANSCE-FO)

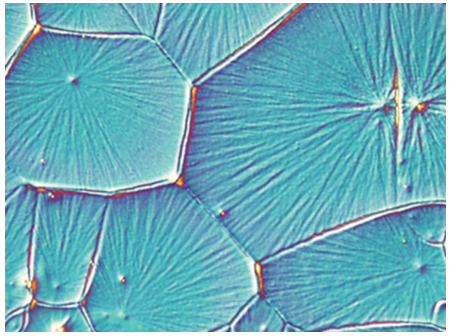
Enabling safe and secure world-class research and accelerator operations

Physics (P)



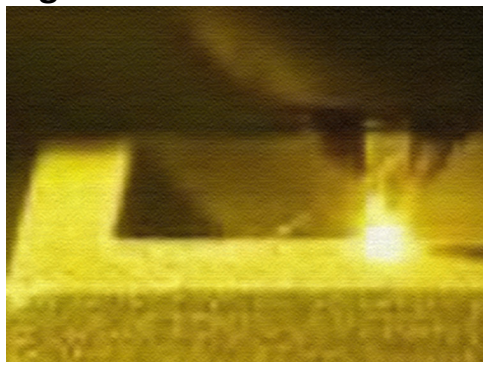
Furthering understanding of the physical world and generating new/improved technology in experimental physics

Materials Physics and Applications (MPA)



Executes and develops explosive science and shock physics programs through the fabrication and application of energetic materials and use of large-scale research gun systems. Dynamic Experiments produces and certifies large scale high explosives components and conducts high explosive science and shock physics experiments and modeling, studying dynamic-system and material response.

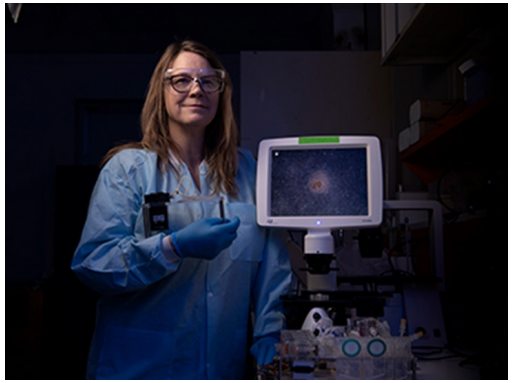
Sigma Division



Operates, maintains, and constructs infrastructure in direct support of mission-focused research and development efforts. The division ensures readiness in mission execution, operations, and maintenance at over 500 facilities across 23 square miles, including nuclear, accelerator, and high explosives portfolios.

Associate Laboratory Directorate – Chemistry, Earth and Environmental Sciences, Bioscience, and Applied Energy (ALDCELS)

Applied Sciences (SPO-AE)



The Applied Energy Office is LANL's interface with DOE for energy security. Energy-related work ranges from new energy concepts, to reduced impact, to improved infrastructure. Example areas of research include fuel-cells, bioenergy, grid, subsurface fossil, CO2, hydrogen, and geothermal resources.

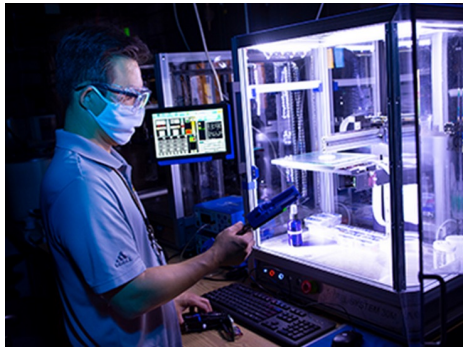
Earth and Environmental Sciences (EES)

The Earth and Environmental Sciences (EES) division is the intellectual home of Earth, atmosphere, hydrology, and ecology disciplines at the Laboratory. Fundamental discovery science and mission-focused applications unravel poorly understood processes and support decisions of national importance.

Bioscience (B)

Bioscience (B) division comprises a diverse group of experimentalists and computer scientists who serve the Nation through research and development addressing natural and deliberate biothreats to human populations, their way of life, and the global ecosystem.

Chemistry (C)



Chemistry (C) division work includes defense, forensics, nonproliferation, energy, civilian R&D, and partnering. Capabilities include analytical chemistry and measurement science; physical chemistry and molecular spectroscopy; isotope and actinide science; nuclear and radiochemistry; nanoscience; material processing and characterization; and chemical engineering.

Other Associate Laboratory Directorates

ALDPI – Plutonium Infrastructure

Executing the plutonium pit production mission through modernization of the TA-55 infrastructure and capabilities. With a focus on the 30-pits-per-year mission, ALDPI manages major equipment installations and capability-based investment projects throughout the Pajarito Corridor.

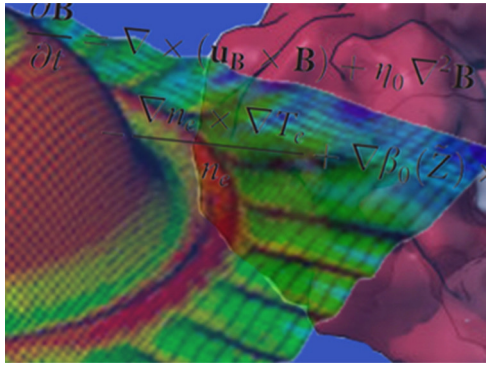
ALDGS – Global Security

The Global Security Directorate is committed to protecting our Nation against emerging, prolific, and unconventional nuclear threats, regardless of origin. Global Security's line and program offices concentrate on Nuclear Nonproliferation, Nuclear Counterproliferation, and Counter Terrorism focusing on known and emerging threats including bio, cyber, and space.

ALDX – Weapons Physics

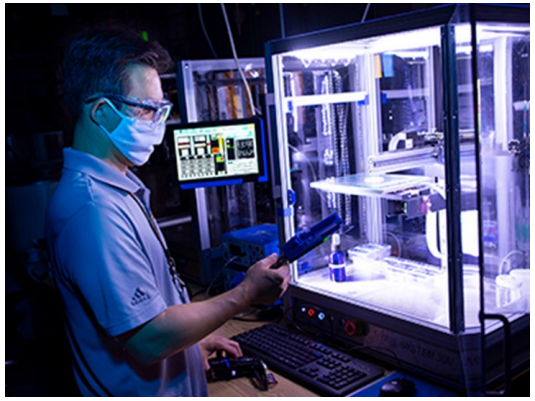
Sustaining the stockpile, providing options for the future stockpile and assessing global nuclear security threats. To execute our mission, we develop and apply cutting-edge theory, computational models and multi-physics simulation codes, and we design, execute and analyze complex experiments.

ALDSC – Simulation and Computation



The Simulation & Computation Directorate advances the frontiers of modeling, simulation, and computation essential to LANL's science and security missions. Our simulation and computation work is central to improved understanding, control, and prediction of complex natural and engineered systems. Through multidisciplinary co-design we engage theory, experiment, and observation to explore, develop and deploy cutting edge, robust, computational tools, infrastructure, and capabilities.

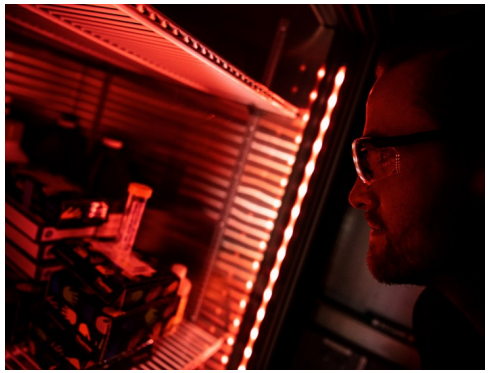
DD - Operations



The dedicated individuals who comprise the vast Operations team strive to enable mission success and execute sustained operations that are reliable and responsive to mission needs. Operations is made up of four Associate Laboratory Directorates, and one Office, including: Business Management; Capital Projects; Facilities & Operations; Environment, Safety, Health, Quality, Safeguards, and Security; Mission Assurance & Prime Contracts Office.

Associate Laboratory Directorate – Weapons Engineering (ALDW)

Engineering Technology and Design (E)



Provides innovative engineering solutions while stewarding and expanding capabilities to develop answers for tomorrow's evolving threats. Engineering, Technology, and Design provides diverse R&D solutions and a broad range of capabilities including requirements definition, design, analysis, fabrication, assembly, testing, and evaluation.

Integrated Weapons Experiments (J)

Executes large-scale, integrated experiments with emphasis on subcritical experiments, hydrodynamic tests, focused experiments, and tests of complex engineered systems. Integrated Weapons Experiments employs multi-disciplinary teams and state-of-the-art diagnostics on these experiments to deliver extraordinary data for customers.

Dynamic Experiments (M)

Executes and develops explosive science and shock physics programs through the fabrication and application of energetic materials and use of large-scale research gun systems. Dynamic Experiments produces and certifies large scale high explosives components and conducts high explosive science and shock physics experiments and modeling, studying dynamic-system and material response.

Weapon Stockpile Modernization (Q)

Provides innovative engineering solutions while stewarding and expanding capabilities to develop answers for tomorrow's evolving threats. Engineering, Technology, and Design provides diverse R&D solutions and a broad range of capabilities including requirements definition, design, analysis, fabrication, assembly, testing, and evaluation.

Weapon Systems Engineering (W)

Provides the program management and system engineering necessary to sustain the safety, reliability, and security of the legacy nuclear stockpile. The division generates key certification data for annual assessments on the health of certain warheads. This role demands ongoing surveillance of the active stockpile and evaluation of the potential impact of any issues.

Weapons Facilities Operations (WFO)

Operates, maintains, and constructs infrastructure in direct support of mission-focused research and development efforts. The division ensures readiness in mission execution, operations, and maintenance at over 500 facilities across 23 square miles, including nuclear, accelerator, and high explosives portfolios.

92% of the Weapons in the Current US Stockpile

The Weapon Systems Engineering Division (W) provides the system engineering and program management necessary to sustain the safety, reliability, and security of the Los Alamos National Laboratory's assets in the active United States nuclear stockpile - the B61, W76, W78 and W88. The Division generates key certification data for Annual Assessment supporting the Laboratory Director's letter to the President on the health of those warheads. This role demands ongoing surveillance of the active stockpile and evaluation of the potential impact of any issues through design, engineering, fabrication, testing using state-of-the-art computational simulation tools and engineering test facilities. The Division works in close liaison with the several production facilities across the nuclear security complex as well as with the customers in the US Navy and Air Force.

Los Alamos NATIONAL LABORATORY

Los Alamos Nat'l Lab Weapon Systems Engineering Division (W)

Offices

- W-EP, Engineering Programs
- W-UCSC, Use Control Coordinator
- ***W-NES, Nuclear Explosive Safety***
- W-MSO, Military and Stockpile Ops
- W-DES, Digital Engineering Strategy

Groups

- W-1 , B61 Systems Engineering
- W-2, W76 Systems Engineering
- W-3, W78 Systems Engineering
- W-4, W88 Systems Engineering
- W-8, Production Liaison
- W-9, Weapon System Surveillance
- W-10, Weapon System Safety Analysis
- W-11, Weapon Production Definition
- W-13, Advanced Engineering Analysis

- Designed and built in 1966. It has not been started since 1992 (Last US Nuclear Test - Implementation of the Test Ban Treaty)
- You can disassemble it and put it back together.
- You can test all the sub-systems (Battery, Starter, Pistons, Gasoline, Etc)
- HOWEVER – YOU CANNOT START IT!!
- Can you guarantee the President of the United States that it will start on the very first try?

Los Alamos NATIONAL LABORATORY

Los Alamos Nat'l Lab Weapon Systems Engineering Division (W)

Offices

- W-EP, Engineering Programs
- W-UCSC, Use Control Coordinator
- ***W-NES, Nuclear Explosive Safety***
- W-MSO, Military and Stockpile Ops
- W-DES, Digital Engineering Strategy

Groups

- W-1 , B61 Systems Engineering
- W-2, W76 Systems Engineering
- W-3, W78 Systems Engineering
- W-4, W88 Systems Engineering
- W-8, Production Liaison
- W-9, Weapon System Surveillance
- W-10, Weapon System Safety Analysis
- W-11, Weapon Production Definition
- W-13, Advanced Engineering Analysis

Can you also guarantee the President of the United States:

- **It will not go of in an accident.**

AND

- **It will not go off due to a malevolent insider**

AND

- **It will go off only if we really, really want it to.**

Los Alamos NATIONAL LABORATORY

Nuclear Explosive Safety Office (W-NES)

Prevent unintended nuclear detonation!

1. For all nuclear explosive operations, there must be a positive measure that will effectively interrupt each credible scenario that leads to an unintended nuclear explosive detonation.
2. For all nuclear explosive operations, there must be a second independent positive measure that will effectively interrupt each credible scenario that leads to an unintended nuclear explosive detonation.
3. There must be positive measures to prevent unauthorized access, intentional physical damage, misuse, and theft of nuclear explosives.
4. There must be positive measures (a combination of site, facility, or nuclear explosive operation-specific as appropriate) to prevent malevolent acts that could lead to deliberate unauthorized use.

- From DOE Order 452

W-Division Capabilities

- Engineering (quality, requirements, software, surveillance, systems, test)
- Ground, flight, and hydrodynamic qualification testing
- Military liaison
- Model-based design drafting
- Nuclear Explosive Package design, system engineering, and system integration
- Nuclear explosive safety
- Production liaison
- Use Control
- Weapons Response

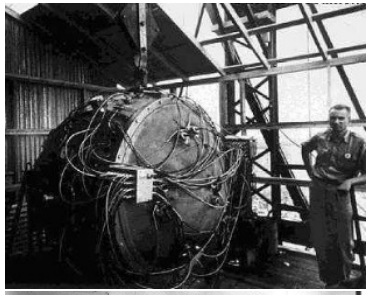
Weapons Stockpile Modernization Division (Q-DO)

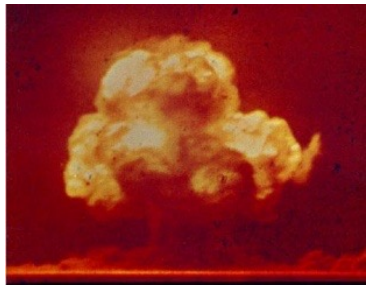
Q Division brings its system engineering and program management expertise and state- of-the-art simulation and experimental capabilities to roles ranging from basic and applied research and development; component technology conceptualization and maturation; through to sub-system and system testing of flight and integrated performance.

Q-Division Capabilities

- Advanced surety and safety systems
- Data processing, environmental analysis, and requirements development
- Development of Safety and Surety Architectures and Assessment Methodologies
- Firing system, detonator, and actuator design
- Gas transfer system (GTS) and GTS related design
- Ground, flight, and hydrodynamic qualification testing
- New weapon system design (W93)
- NNSA business practice
- Nuclear Explosive Package design, system engineering, and system integration

Precision Detonators were a requirement of the Manhattan Project





1943: The Manhattan Project

- Neddermeyer proposed using HE to assemble an atomic bomb using converging detonation waves
  - Explosives were regarded as uncontrollable destructive forces rather than precision tools
  - Blasting caps with primary explosives were unsafe and did not provide the timing necessary

1945: Trinity Test

- The 1773 EBW detonator with PETN was developed and used on the Trinity Test.
  - PETN replaced Lead Azide, which improved safety
  - 1773 provided the precision timing required

"About one week before Trinity, the 1773 EBW detonator was declared to be the best of the competing detonator types. The 1773 EBW detonators were used on the weapon tested at Trinity and subsequently on the weapon dropped at Nagasaki."

-Tucker Detonator History

Engineering Technology and Design Division (E-DO)

E Division is involved in every phase of the engineering process: requirements definition, design, analysis, fabrication, assembly, and testing and evaluation.

E-Division Capabilities

- Advanced engineering analysis
- Assembly engineering
- Cryogenics
- Glovebox design and integration
- Industrial engineering
- Instrumentation and control development
- Mechanical design, fabrication, and testing
- Nondestructive testing and evaluation
- Nuclear process design
- Process automation and robotics
- Process modeling
- Radiography
- Risk analysis
- Systems engineering
- Thermal design and analysis
- Weapon assembly
- Weapon environmental testing

Integrated Weapons Experiments Division (J-DO)

J Division addresses national security challenges by executing mission-driven, large-scale integrated experiments, emphasizing subcritical experiments, hydrodynamic tests, focused experiments, and tests of engineered systems at multiple firing sites and use of the Dual-Axis Radiographic Hydrodynamic Test (DAHRT) facility.

J-Division Capabilities

- Accelerator and beam physics
- Accelerator operations
- Data analysis
- Develop and field x-ray and related diagnostics
- Dynamic structure R&D
- Experiment and diagnostic probe
  - design and construction
- Experiment integration (designing, modeling, and conducting integrated experiments)
- High Explosive (HE) fabrication and disposal (pressing, sawing, machining, inspection, HE waste treatment)
- High Explosive operations
- Mechanical engineering and maintenance
- Technical and operational expertise in planning and executing complex and hazardous system/subsystem tests
- Vessel operations (fielding, cleanout, repair, and procurement)

Explosive Science and Shock Physics Division (M-DO)

M Division is responsible for ongoing and expanding explosive science and shock physics efforts including the Dynamic Equation of State (DEOS), a new shock physics research facility.

M-Division Capabilities

- Analytical chemistry
- Dynamic properties of materials
- Explosives detection
- Gas and powder gun
- High explosive (HE) crystal growth
- High explosive pulsed power
- High explosive science
- Investigations of reacting energetic materials
- Materials synthesis and formulation
- Processing, characterizing, and examining new and traditional HE
- Reactive flow modeling
- Shockwave compression of organics and shock-induced chemistry
- Shockwave initiation and detonation physics
- Small-scale safety, sensitivity, and performance testing of energetic materials

Weapons Facilities Operations Division (WFO-DO)

WFO Division is charged with facilitating mission execution at the Weapons Engineering Tritium Facility (a Hazard Category II nuclear facility), DARHT, High Explosive Sciences, Firing Sites, and Detonator Facilities.

WFO Capabilities

- Access control
- Engineering
- Environment, safety, and health (environmental management, industrial
- hygiene and safety, radiation protection, waste management)
- High Explosive operations and safety
- Maintenance and work control
- Operations support
- Safety basis
- Training

Employee Benefits: The Science of Living Well

Health and wellness

- Medical: 2 options through Blue Cross Blue Shield of New Mexico (HDHP, PPO)
- Dental: preventative care and orthodontics through Delta Dental of New Mexico
- Vision: complete vision care through Davis Vision
- Wellness Program: incentivized wellness program and onsite fitness and medical facilities

Financial security and protection

- Retirement Plans: 401(k), Roth 401(k), company match up to 6%, service-based contribution starting at 3.5%
- Life Insurance: various options including basic, supplemental, dependent, and AD&D
- Disability: short-term and long-term plans through MetLife
- Legal: access to licensed attorneys and identity theft coverage through ARAG
- Tax-Advantage Plans: set aside pre-tax monies through payroll deductions for health, dependent care, and adoption assistance.

Employee Benefits Continued…

Professional development

- **ALDW Mentoring Program**: build networks and expand career opportunities through one-on-one mentorship
- Education Assistance Program: reimbursement for the cost of tuition, fees, and books
- Texas A&M and University of California in- state tuition: eligible dependents of full- time employees can apply for resident status for tuition purposes
- **Weapons University**: professional training

Work-life balance

- Alternative work schedules: 9/80 schedule with a Friday off every other week
- Holidays and PTO: 10 paid holidays per calendar year, 200-256 hours annual accrual rate based on years of service for personal/family sick days and vacation
- Paid Maternity Leave: 100% pay for up to 6 consecutive weeks after birth
- Paid Parental Leave: 100% pay for up to 3 consecutive weeks within 12 months after birth/adoption

WESH – Weapons Engineering Study Hall

- So, since you didn't major in Nuclear Weapons in College, how do we teach you about Nuclear Weapons?
- Modules on:
  - Trinity, Primaries, Explosives, Secondaries, Components
  - Evolution of the Stockpile
  - Bomb Weapons, Ballistic Weapons
  - Systems Engineering, Production, Assembly
  - Technology Development and Future Options
- Tours of Facilities at LANL and the country
- Two year program
  - early to mid career development
  - Part of our Weapons University Initiative

WESH Cohort Trip to Trinity Site is one of many unique opportunities at Los Alamos National Lab

No, we do not

GLOW

at night!

(At least most of us.)

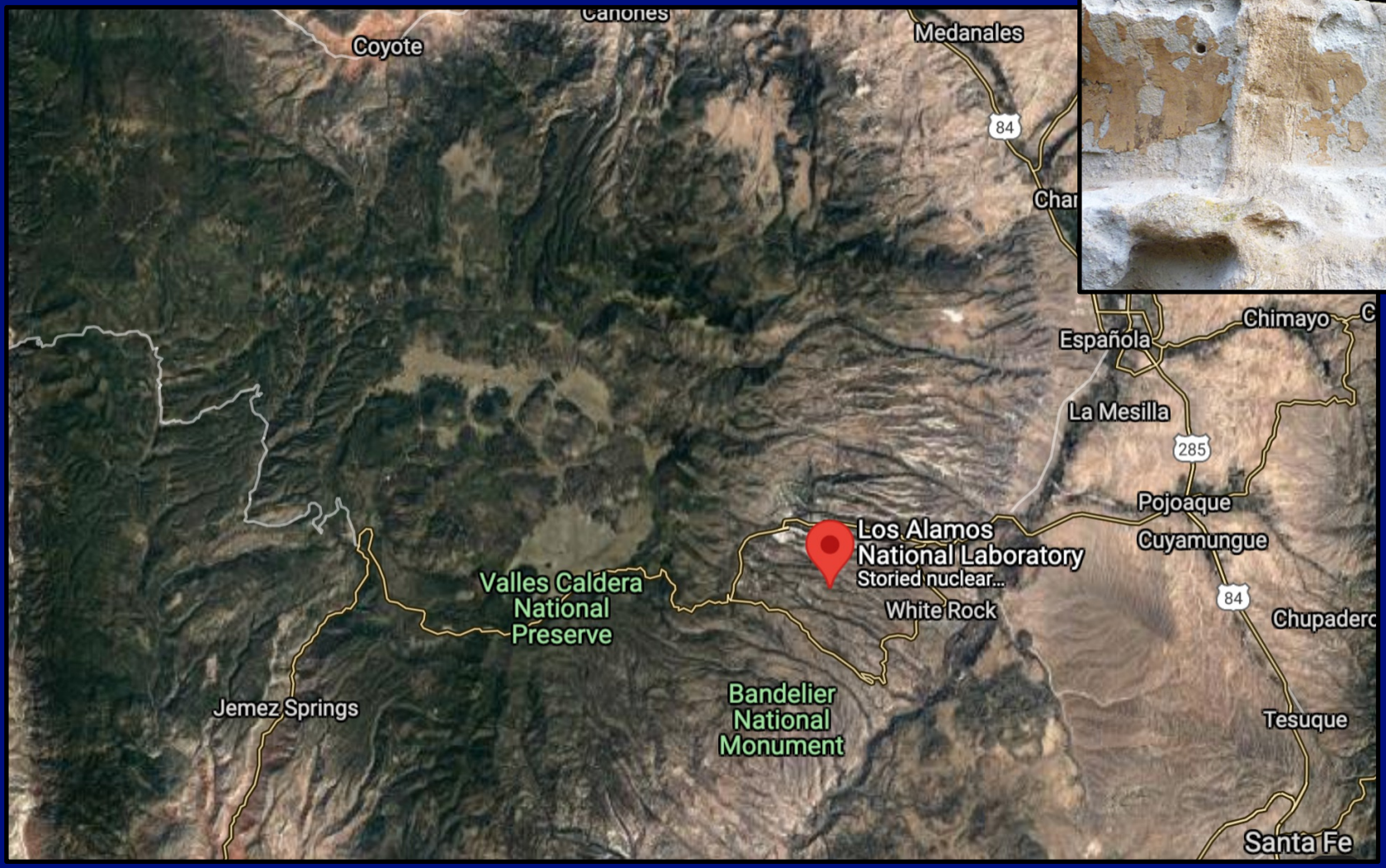
Los Alamos NATIONAL LABORATORY

Los Alamos, New Mexico

- Elevation – 7,300 ft (10,440 ft ski hill)
- Population – 13,200
  - 17.7% have PhDs (highest in US)
  - 13.2% are millionaires (highest in U.S.)
- #1 Best Place to Live in America (2004)
- Healthiest County in the U.S. with avg. life expectancy of 83.4 years. (U.S. avg. is 77.5)
  - Skiing: 5 mi. from dtwn, 40 trls/300 acres.
  - Hiking: 150 miles of hiking trails
  - Swimming: Olympic-sized aquatic center
- Nearest mega-volcano – 7 miles
- Nearest Walmart – 21 miles
- # of McDonald's Fast Food Restaurants – 1
- # of LDS Wards – 3 in Los Alamos
- Nearest LDS Temple – Albuquerque(89 miles)
- Most common question – "Red or Green?"
  Most correct answer – "Christmas"

LA-UR-22-20729

Los Alamos, New Mexico Outdoor Attractions



LA-UR-22-20729

Los Alamos, New Mexico
Famous Permanent Residents

LA-UR-22-20729

Join Our Team!

ALDW early and mid-career open positions

- Post Bachelors Internship
- Post Masters Internship
- Engineering Technologist 1-2
- Control Engineer 1-2
- R&D Engineer 1-2

LANL internship programs

- Student Programs Office
- Undergraduate Internship Program
- Graduate Internship Program

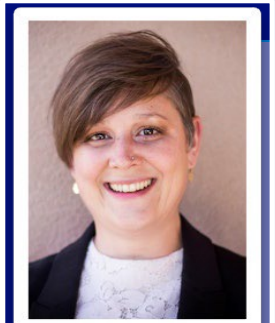
Scan the QR code to view all the opportunities in ALDW or visit this link.

Visit https://lanl.jobs/ to view all the opportunities at LANL.

Contacts

Manny Garcia

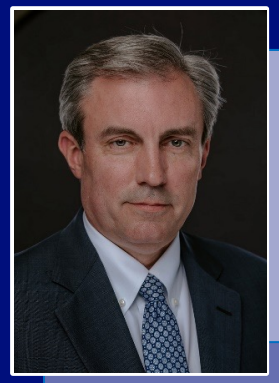
Program Director
Staffing & Professional Development
Weapons Engineering
mgarcia@lanl.gov



Cassandra Casperson

Program Manager
Staffing & Professional Development
Weapons Engineering
casperson@lanl.gov

Contacts



Paul Peterson

Program Director
W-NES (Nuclear Explosive Safety)
Weapons Engineering
pdp@lanl.gov

Steven Clarke

Principle Scientist
Detonation Science and Technology
Stockpile Modernization
sclarke@lanl.gov

Example Search #1:

- Go to https://lanl.jobs/
- Keyword – “Chemistry”
- Category – “Student – Undergraduate”

SEARCH

- **Example Search #2:**
- Go to https://lanl.jobs/
- Keyword – “Mechanical”
- Category – “Engineering”

SEARCH

Los Alamos
NATIONAL LABORATORY

We expect to hire 2,000 Full-time employees in 2024.

We expect to hire 1,500 student interns this summer.

For more information:
https://www.lanl.gov

To search jobs and submit an application
https://www.lanl.gov/careers/index.php

https://women.lanl.jobs/

https://www.lanl.gov/careers/career-options/student-internships/index.php

Contacts: Paul D. Peterson (pdp@lanl.gov)
Steve Clarke (sclarke@lanl.gov)

"What are you interested in?"

"What do you want to do?"

ALDW Open Roles