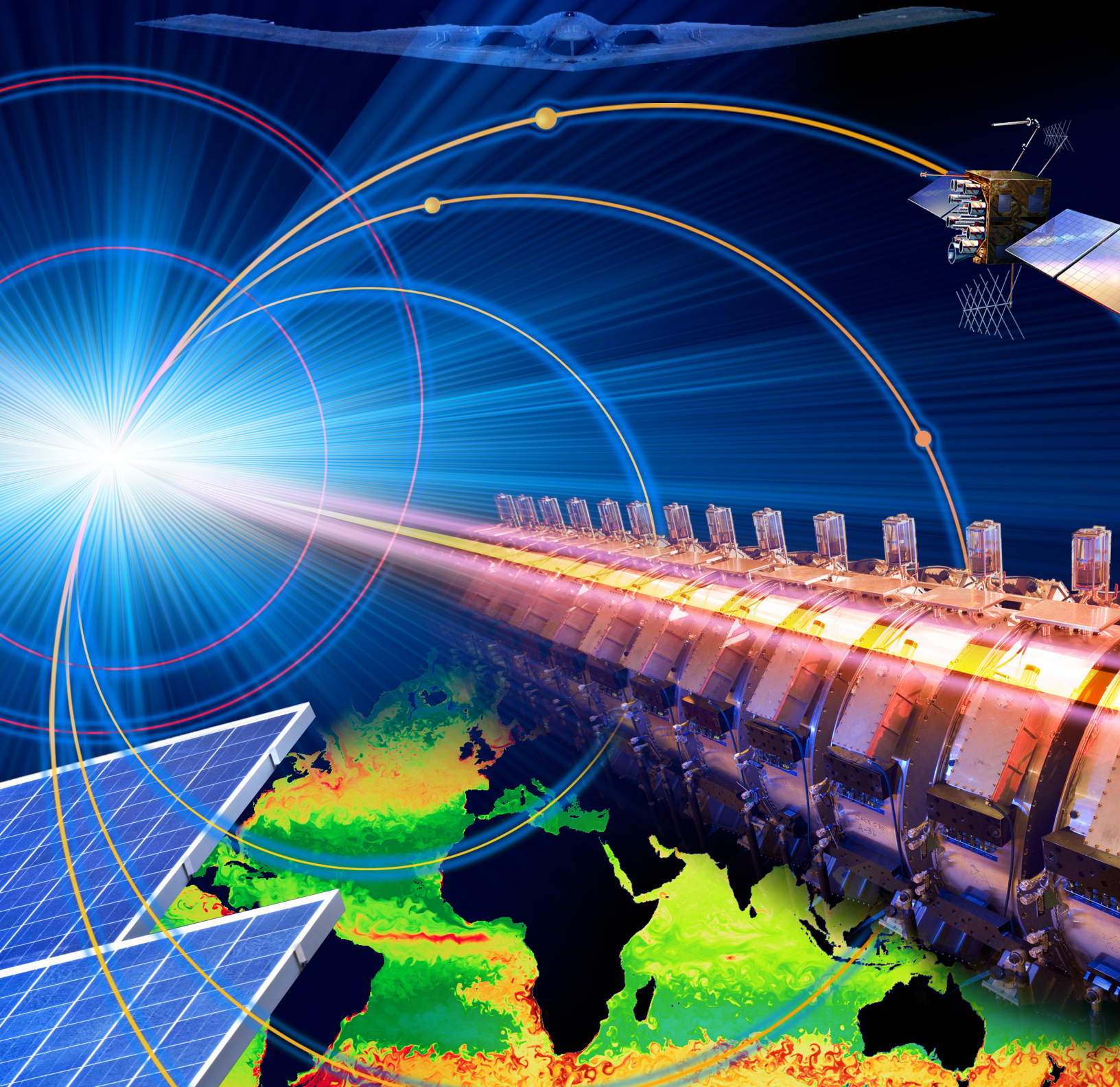
PROUD LEGACY
BOLD FUTURE

LOS ALAMOS NATIONAL LABORATORY STRATEGIC PLAN 2014



PROUD LEGACY

Los Alamos National Laboratory has a proud history and heritage of 70 years of science and innovation. Great minds and multi-disciplinary teams were gathered to perform a scientific, technical, and engineering feat never before accomplished, to solve a crucial national security concern, over an astonishingly short period of time. The remarkable people of our first scientific project, The Manhattan Project, created our proud legacy.

BOLD FUTURE

Our predecessors unleashed their creativity, innovation, and genius to end WWII, and in doing so drove science to levels the world had never seen. The extraordinary spirit that transformed the world is still in our institutional DNA–it is who we are.

Today, national security threats are continually evolving and disruptive technologies have become the norm. These changes are occurring at a time of fiscal constraint. Challenging times call for exceptional technical leadership. Los Alamos can uniquely provide this leadership.

We serve the nation by applying world-changing science and technology to current and emerging national and global security challenges. To fulfill our commitments, we will be cost effective, efficient, and operate with quality and reliability. We welcome a diverse workforce that ensures the talent necessary for our success.

Three themes lie behind this strategy–themes that have been part of my thinking since I began leading the Laboratory:

- We will deliver on commitments today while ensuring capabilities for an uncertain future.
- We will make Los Alamos National Laboratory one of the best places in the world to work.
- We will be a laboratory that works seamlessly.

This document sets the stage for implementation plans that will take these themes from concepts to actions. Our people and strengths will be tested in a dynamic national security environment. We must meet these challenges with scientific and technical excellence.

Please join me.

Charles F. McMillan, Director

April 2014

Los Alamos Director Charles McMillan, left, and Secretary of Energy Ernest Moniz

Our Strategy Aligns with National Security Priorities

As a Federally Funded Research and Development Center, we align our strategic plan with priorities set by the Department of Energy (DOE), the National Nuclear Security Administration (NNSA), and key relevant national strategy guidance documents, such as the *Nuclear Posture Review*, the *National Security Strategy*, and the *Blueprint for a Secure Energy Future*. As the senior laboratory in the DOE system, we execute work in all of DOE's missions: national security, science, energy, and environmental management. Our contributions are part of what makes DOE a science, technology, and engineering powerhouse for the nation.

In addition, we perform work for the Department of Defense (DoD), Intelligence Community (IC), and Department of Homeland Security (DHS), among others. As a result, our strategy reflects U.S. priorities spanning nuclear security, intelligence, defense, emergency response, nonproliferation, counterterrorism, energy security, emerging threats, and environmental management.

We focus on integrating research and development solutions to achieve the maximum impact on strategic national security priorities. In addition, through our partnerships across government agencies, laboratories, universities, and industry, we deliver the best possible science and technology results for the nation.

Los Alamos is operated by Los Alamos National Security, LLC (LANS) under contract to the NNSA. LANS comprises four U.S. organizations that partner to support delivery of our national security science mission. These entities are the University of California; Bechtel National, Inc.; The Babcock and Wilcox Company; and URS Corporation.

Our vision, mission, and goals express our commitment to continuing the proud tradition of mission delivery and scientific excellence far into the future.

OUR VISION

Delivering science and technology to protect our nation and promote world stability

OUR MISSION

To solve national security challenges through scientific excellence

OUR VALUES

We value our people and the extraordinary talents brought to Los Alamos to accomplish our mission. Our values demonstrate this point and communicate the essence of the Laboratory:

SERVICE:	Serving our country, our partners, our community, and each other
EXCELLENCE:	Ensuring timely mission execution through scientific, operational, and business excellence
INTEGRITY:	Building trust through intellectual honesty, ethical conduct, and individual responsibility
TEAMWORK:	Collaborating with colleagues and partners, respecting diverse opinions and backgrounds, vigorously debating alternatives, and coming together to achieve the best solutions
STEWARDSHIP:	Being good stewards of the taxpayers' dollars, the Laboratory, our community, and the environment
SAFETY & SECURITY:	Ensuring that safety and security are integral to everything we do

OUR GOALS

- Deliver national nuclear security and broader global security mission solutions; and
- Foster excellence in science and engineering disciplines essential for national security missions; by
- Attracting, inspiring, and developing world-class talent to ensure a vital future workforce; and
- Enabling mission delivery through next-generation facilities, infrastructure, and operational excellence.

GOALS

Deliver national nuclear security and broader global security mission solutions

We will maintain the nation's full confidence and trust through our technical prowess, scientific integrity, and reliable delivery of solutions.

Strategies

- Provide a safe, secure, and effective stockpile
- Protect against the nuclear threat
- Counter emerging threats and create new opportunities
- Provide solutions to strengthen energy security

and

Foster excellence in science and engineering disciplines essential for national security missions

We will ensure agile mission responsiveness by advancing exceptional science and engineering in targeted strategic disciplines.

Strategies

- Sustain a culture of excellence to ensure the quality and integrity of our science and engineering solutions
- Strategically invest in breakthrough science and engineering
- Lead in transformational science at extremes

by

Attracting, inspiring, and developing world-class talent to ensure a vital future workforce

We will shape our excellent technical, operational, and professional talent for evolving national security needs through recruiting, retention, and talent development.

Strategies

- Position the Laboratory to compete for and attract world-class talent
- Develop and mentor next-generation workforce and leadership talent
- Position the Laboratory as one of the best places to work

and

Enabling mission delivery through next-generation facilities, infrastructure, and operational excellence

We will create a modern workplace that is environmentally responsible, safe, and secure.

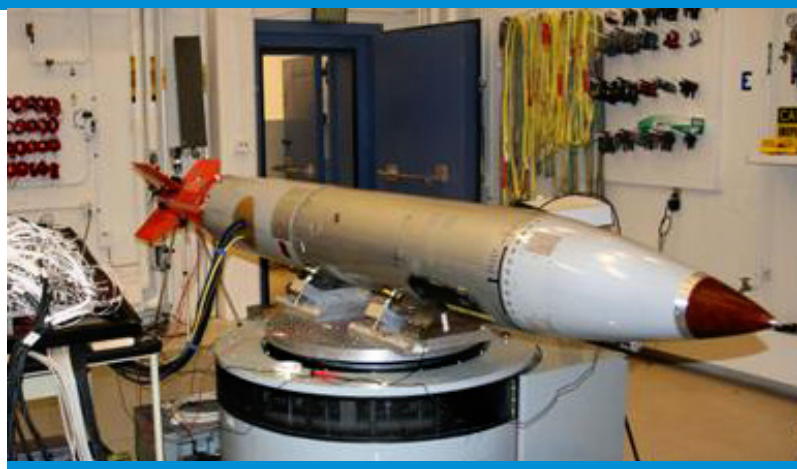
Strategies

- Demonstrate leadership in environmental stewardship, commitment to sustainability, and social responsibility
- Transform our infrastructure to enable scientific breakthroughs
- Drive productivity and innovation in all aspects of operations, business systems, and information systems
- Protect our people, our assets, and our information

How We Serve the Nation

Los Alamos serves the nation by solving national security challenges through scientific excellence. Our primary mission drivers are to:

- Provide a safe, secure, and effective stockpile;
- Protect against the nuclear threat;
- Counter emerging threats and create new opportunities; and
- Provide solutions to strengthen energy security.



In February 2014, NNSA announced that Los Alamos and Sandia national laboratories successfully completed the first full-system mechanical environment test of the B61-12 as part of the NNSA's ongoing effort to refurbish the B61 nuclear bomb.

Plutonium Center of Excellence for the Nation

As the Plutonium Center of Excellence for the nation, Los Alamos provides scientific leadership and collaborates with other DOE/NNSA laboratories to meet the plutonium needs of the nation.

To ensure the advancement and sustainability of plutonium capabilities, Los Alamos developed an Integrated Plutonium Science and Research Strategy that defines three goals:

1. Integrated plutonium and actinide science, technology, and engineering
2. Retention and recruitment of a world-class workforce
3. A modern and sustainable infrastructure

We are integrating people, materials, and processes into an infrastructure that delivers products and flexibly addresses evolving needs. To mitigate the significant time and resources required for the acquisition of new nuclear facilities, we adopted a phased approach that cost effectively upgrades our existing plutonium facility and incorporates a modular process for the acquisition of new facilities.

Change is inevitable, and the pace of change is accelerating. Malevolent actors are using technology to harm the nation in ways that require us to be more flexible in our response. To continue to serve the nation, we will drive science and technology innovation for national security at a pace that matches or anticipates the ever-changing threats and opportunities.

Nuclear Deterrence and Stockpile Stewardship

The President and Congress determine the role of nuclear weapons in our nation's security strategy. While the overall size of the stockpile is the smallest it has been in more than 60 years, there is strong agreement among policy makers that "as long as nuclear weapons exist, the nation will maintain a safe, secure and effective arsenal." Nuclear weapons serve as a deterrent to potential U.S. adversaries. They also serve to assure U.S. allies that the U.S. security guarantee remains unquestioned, providing a security hedge in a very uncertain world.

Los Alamos Systems Responsibilities

Los Alamos has primary responsibility as the design agency for four of the seven nuclear weapons systems in the enduring stockpile. These systems constitute the majority of the nation's on-alert deterrent. They are:

- W76, carried by the U.S. Navy's Trident missile submarines;
- W88, carried by the U.S. Navy's Trident missile submarines;
- B61 gravity bomb, deployed to a variety of strategic and tactical aircraft; and
- W78, carried by the U.S. Air Force's Minuteman III intercontinental ballistic missiles.

These four systems span a triad of launch platforms (submarines, aircraft, and land-based missiles), providing a strong and flexible nuclear deterrent.

In the absence of full-scale nuclear weapons testing and new weapons production, the nation's confidence in the aging and smaller stockpile relies upon the expertise of our scientists and engineers. Their judgment is informed by historical nuclear test data, modern experiments yielding new data, and validated models and simulations. Our experts use advanced experiments and high-performance computational capabilities to ensure the safety, security, and effectiveness of the U.S. nuclear stockpile without full-scale underground nuclear testing.

Annual Assessments

Each year, the Laboratory is required by law to conduct a rigorous analysis of its stockpile systems to support an annual assessment report. This report, which evaluates the continued safety, security, and effectiveness of Los Alamos-designed stockpile systems, is delivered by the Laboratory Director to the President through the secretaries of Energy and Defense.

The photo above shows a test launch of a Trident II D5 missile. The Trident II missile is capable of carrying Los Alamos-designed W76 or W88 warheads.

Life Extension Projects

Through Life Extension Project activities, Los Alamos scientists and engineers extend the lifetime of warheads and bombs beyond their original designed service life. These activities address issues and concerns that are identified through surveillance and replace components to extend weapons service life. They also allow the opportunity to install enhanced safety and security features in existing weapons to meet current and future security environments. Executing these activities requires Los Alamos to have leading-edge materials, experimental, computational, simulation, and engineering capabilities. These same tools, technologies, and people allow us to promptly and effectively respond to the new and emerging threats of the 21st century.

Protecting Against the Nuclear Threat

Los Alamos protects our nation against the nuclear threat—emerging, proliferant, or unconventional—regardless of origin. We exercise our abilities in nonproliferation and counterproliferation to interdict the spread of nuclear technology to emerging nuclear states. We also use these abilities to protect against unconventional transnational threats and support counterterrorism and emergency response to nuclear-related events. We can address each of the interrelated phases in the notional history of a potential nuclear event, from motivation and planning through post-event response and recovery and forensic analysis, as seen in the figure below. This analysis spans program and mission activities across the DOE, DoD, and IC and strengthens our ability to successfully execute our mission.

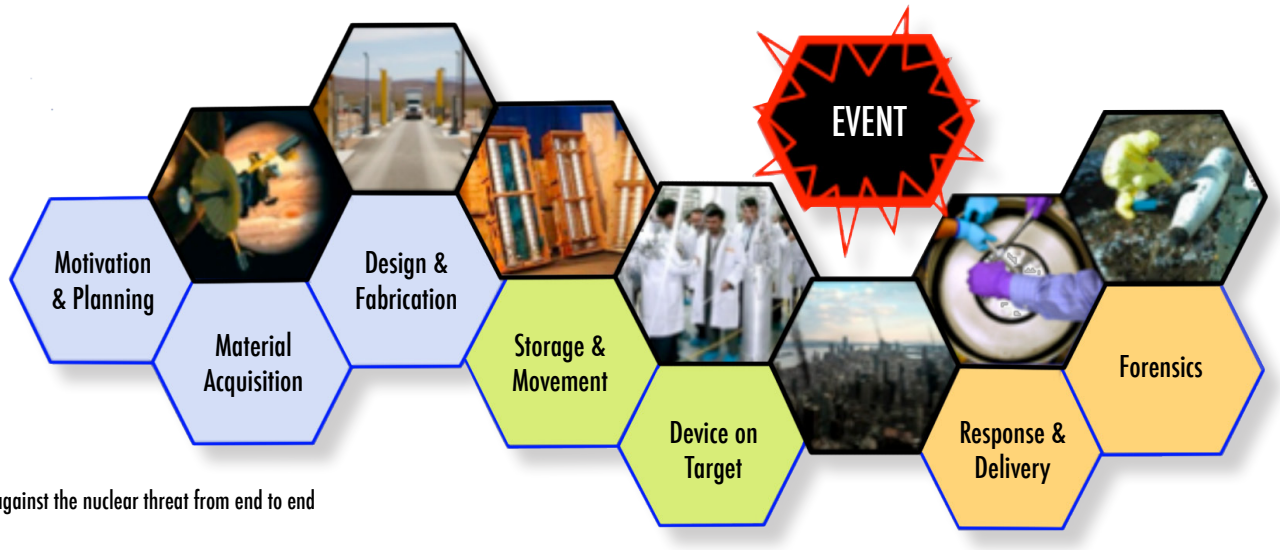
Our strength in responding to threats derives from the synergy between our Weapons and Global Security programs. We apply our core weapons expertise to assess foreign weapons and nuclear programs and threats posed by improvised nuclear devices. Global Security programs also leverage industrial partnerships, particularly for moving ideas into innovations, fielded systems, and products.

The need to respond rapidly with accurate analysis and effective technology is increasing as national threats grow more asymmetric and technology and information are more universally accessible to our adversaries. Los Alamos provides quick responses to requests from the DoD and IC for information, analysis, and potential solutions to support their decision making and actions across the spectrum of national security threats. Specific examples include military warfighter support, space defense, and rapid prototype deployment. As a member of the IC through the Los Alamos Field Intelligence Element, we rapidly and knowledgably engage in all of these activities.

Agile Space-Based Sensing and Science for Treaty Monitoring

From the first Vela satellite launched at the dawn of the space age 50 years ago to the latest global positioning system satellites being deployed today, Los Alamos' sensing instruments and payloads continue to meet evolving national needs. Along the way, we have developed core capabilities in advanced sensors, electronics, space weather, astrophysics, and data exploitation and continue to transition these advances to areas ranging from fundamental space science to emerging space defense missions.

Maintaining and enhancing a flexible and responsive capability in space science and technology is critical for effective future treaty verification, as well as new space missions.



Protecting against the nuclear threat from end to end

Los Alamos supplies the technical backbone to national and international efforts to understand and limit nuclear proliferation, including effective national technical means to verify compliance with nuclear test ban treaties. We provided the detection instrumentation in the first satellite to monitor a nuclear treaty more than 50 years ago, and we will continue to provide the majority of space-based sensing capabilities needed to keep satellite monitoring systems up to the challenge of changing threats.

Los Alamos scientists are at the forefront of geophysical research to improve the global capability to detect and locate seismic and infrasonic events, identify them as natural or man-made, and estimate the energy release of such events. This research enables the U.S. treaty monitoring mission and supports the International Data Centre under the Comprehensive Nuclear-Test-Ban Treaty organization.

Los Alamos develops transformational technologies to better recognize nuclear and radiological threats. We lead the nation's efforts to strengthen the capabilities of allies and other countries to deter, detect, and interdict illicit trafficking of nuclear materials at international border crossings. We also provide technical solutions and support to improve our national ability to detect these materials.

The Multi-Mission Radioisotope Thermoelectric Generator, a nuclear battery, powers the Mars rover, Curiosity, and warms its instruments at night. Technologies such as this also support space defense and other global security missions.

Los Alamos assists with security coverage of National Special Security Events, including presidential inaugurations, national political conventions, and major sporting events by providing radiological search, area monitoring, and analysis and assessment.

Our counterterrorism portfolio includes the development of tools, tactics and procedures, training, event response, forensics, and consequence management for responding to potential nuclear terrorist activities. In particular, we provide nuclear and radiological emergency response teams composed of volunteer Los Alamos employees. These teams are deployed anywhere in the world under severe conditions and short timelines.

Emerging Threats and Opportunities

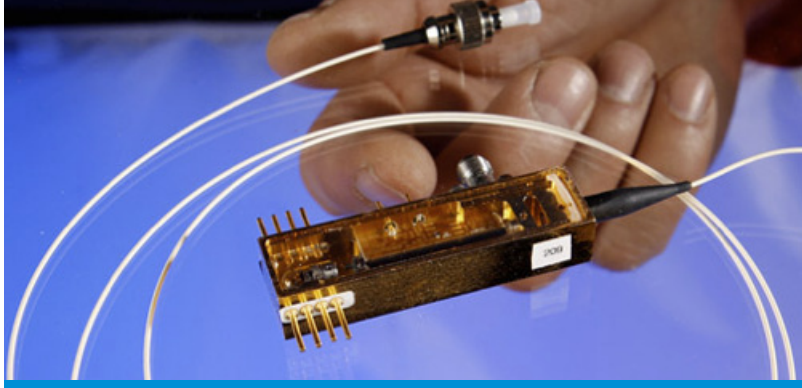
Los Alamos is uniquely positioned to offer comprehensive capabilities to identify, anticipate, and rapidly respond to emerging threats. These threats include cyber-based theft and sabotage, threats from space, and technological surprise. We also provide vital technology for supporting the U.S. military in a world of small-scale, intense conflict. Another important focus is the identification of emerging, game-changing technologies that have the potential to either disrupt or increase our technology advantage in protecting the nation.

The "asymmetric" dimension of threats in today's world has contributed to a significant escalation in potential dangers and the need for an increasingly rapid response. We build and sustain a flexible multidisciplinary science and technology capability base along with specialized experimental facilities and high-performance computational tools for modeling and simulation. We work with the DoD, DHS, and IC to provide technical solutions for prediction and/or prevention of catastrophic threats, counter new foreign strategic and tactical technological advances, and improve national security.

Energy Security Solutions

With energy use increasing across the nation and the world, we apply our expertise to those areas in which energy security needs intersect with our scientific strengths and capabilities. We tackle these challenges through fundamental scientific discovery by harnessing our experimental and high-performance computational modeling and simulation capabilities. We partner with energy industry leaders to develop energy sources with limited environmental impacts and improve the nation's energy infrastructure security, reliability, and efficiency.

A Los Alamos Distinguished Postdoctoral Fellow is synthesizing a carbon nanostructure at the Center for Integrated Nanotechnologies. In the search for the most promising properties to improve energy storage, sensors, and nano-electronics, researchers have established a new capability to synthesize carbon nanomaterials and new approaches to generate hybrid materials from them.



Los Alamos scientists have demonstrated the first-ever use of quantum cryptography to secure electric grid control data. Novel methods for controlling the electric grid are needed to accommodate new energy sources, such as renewables whose availability can fluctuate on short timescales.

Safe and Sustainable Nuclear Energy

As a carbon-free option, nuclear power remains environmentally attractive worldwide. This option drives a national security need for safety, waste management, and controlling the risk of proliferation. We develop engineering and safeguard technologies for future nuclear reactor designs and fuel cycle options, detection technologies needed for global nuclear materials management, and modeling and simulation to support nuclear energy system decisions.

Materials and Concepts for Clean Energy

Our strength in materials science allows us to lead advances in sustainable energy generation, transmission, and storage. Our efforts include smart grid technology, bio- and solar-energy production, fuel cells and advanced hydrogen storage, and high-temperature superconducting materials for electric power.

Mitigating Impacts of Global Energy Demand Growth

Global energy demand is growing rapidly, with cascading effects to our national infrastructure, the environment, and society. We provide measuring, modeling, and predictive simulation capabilities to assist policy makers and defense and intelligence communities in understanding the impact of climate change and the changing energy demand on national security. Our work focuses on resilient adaptations to growing energy demands, from assessment of the impacts of climate change on natural and engineered systems to the capture, use, and storage of carbon dioxide.

Excellence in Science and Engineering for National Security

We must continually sustain and build scientific capabilities to enable agile readiness to respond to uncertain and evolving national security challenges, as well as deliver on our mission commitments today. To achieve these objectives, we will:

- Sustain a culture of excellence to ensure the quality and integrity of our science and engineering solutions;
- Strategically invest in breakthrough science and engineering; and
- Lead in transformational science at extremes.

Sustaining Our Readiness to Respond

As national security threats evolve, our scientific strengths will be tested. We must maintain flexibility in our research and development to respond to future national security challenges. The nation depends on our ability to sustain and nurture scientific excellence. Our people, facilities, infrastructure, partnerships, and overall knowledge base are crucial for the task. We build our future strength and flexibility by strategically engaging in new national missions, growing new research and talent through the Laboratory Directed Research and Development (LDRD) Program, fostering innovation through targeted partnerships, and increasing international scientific engagement through user facilities.

The Mission/Science Cycle of Innovation

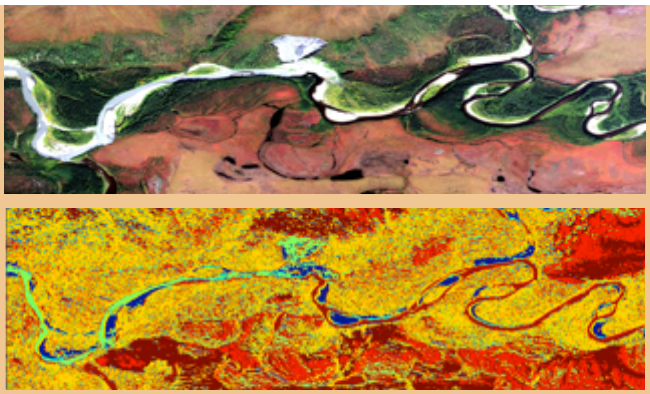
Los Alamos is consistently called upon to apply its assets to a broader set of complex challenges at the national level. Building on our historical core nuclear weapons expertise, we selectively engage in new national missions over time. We use our scientific skills and tools to support our stockpile and global security missions. We recognize the value of bringing these assets to bear on a broader set of national security challenges. In turn, executing these other program areas strengthens our core scientific capabilities, which are essential to a responsive national security center of excellence, completing the mission/science cycle of innovation.

Seeding Discovery Science Through LDRD

The LDRD Program provides the foundation for Los Alamos' long-term scientific and technological vitality to meet our missions. This program is also a major factor in attracting and retaining talent and launching the early careers of a strong

Adapting National Security Science for Climate Observation

As a cornerstone of our science strategy, we use multidisciplinary teams to understand complex systems. A successful example is the adaptation and application of satellite-based remote sensing imagery analysis for monitoring and predicting the evolution of the Arctic as climate warms. Los Alamos researchers use satellite and airborne imagery tools to identify and interpret the "signatures" that indicate thawing permafrost. The combined satellite and airborne datasets are used to quantify the rates of change in the Arctic and evaluate long-term global climate impacts.



Advances in the collection of high-resolution multispectral and topographic datasets are used for the identification of landscape properties. The top panel shows a World View2 image of the Selawik River region in Alaska. The bottom panel shows preliminary output from a classification algorithm from Moody et al. 2012.

scientific workforce. It enables collaborations with academia that feed our scientific recruitment pipeline. More than 60% of the postdoctoral researchers (postdocs) at Los Alamos receive support from the LDRD Program. We make strategic LDRD investments based on systematic annual planning and a competitive peer-reviewed selection process. We use this program to seed our capability base and future leadership to prepare for emerging national security challenges within a 3- to 20-year horizon.

Innovation Through Partnerships

Innovation is the path from scientific creativity to deployment of solutions for worldwide challenges. To drive scientific research and new technologies down this beneficial path, we engage in mutually beneficial partnerships and collaborations with outside entities. Industry partners of all sizes complement our strengths with market insights and an ability to scale solutions in the field. In return, our partners receive access to our cutting–edge research and talent. Through partnerships, we deploy technical solutions that serve national security interests and advance U.S. industrial productivity and competitiveness.

User Facilities Broaden Scientific Impact

Los Alamos leverages the investment in our mission-driven tools to advance basic science and to make these tools more broadly available to outside users. Each year, more than 1,000 users from governmental agencies, international universities, and industry visit these facilities. They come to study, characterize, fabricate, calibrate, test, and evaluate new materials, systems, products, and processes. Through such collaborations, we expand our knowledge in key disciplines, make connections that lead to new innovations, and reinforce our capabilities for science and engineering. These user facilities are a critical component for maintaining the vitality and leadership of our science and engineering capabilities for national security.

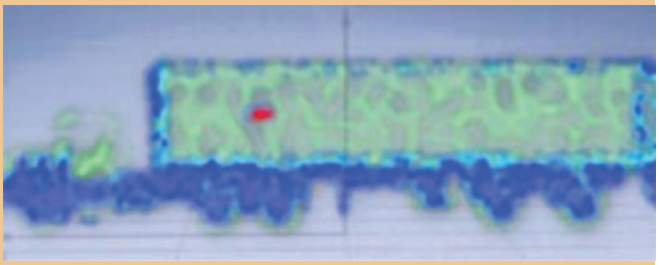
Los Alamos Neutron Science Center (LANSCE): LANSCE has been our flagship experimental facility for basic and applied science for more than 30 years. Research conducted at LANSCE supports national security and civilian applications, including nuclear deterrence, counterproliferation, medical science, and energy. Contained within LANSCE are three designated DOE user facilities: the Lujan Neutron Scattering Center, the Proton Radiography (pRad) Facility, and the Weapons Neutron Research Facility.

Center for Integrated Nanotechnologies (CINT): CINT provides scientists and industry researchers with tools to understand new performance regimes, test new designs, and integrate nanoscale materials and structures. Research at CINT contributes to our strength in materials technologies. CINT is jointly operated by Los Alamos and Sandia national laboratories.

National High Magnetic Field Laboratory (NHMFL): The Pulsed Field Facility at Los Alamos, one of three national sites for the NHMFL, provides users from around the globe access to the world's highest nondestructive magnetic fields—100.8 tesla world record set in March 2012—for materials research specializing in condensed matter physics.

Richard P. Feynman Center for Innovation

The Los Alamos Richard P. Feynman Center for Innovation was established in 2013 to expedite the conversion of new ideas into solutions that protect against adversarial threats based on rapidly changing technology. The Feynman Center staff protect and leverage Los Alamos intellectual property, implement new licensing technologies and software, and manage our industry research partnerships. Through the Feynman Center, we emphasize "mission-focused" technology transition, a focus inspired by Feynman's legacy of creativity and unconstrained thinking about big problems.



The picture above shows a muon tomographic image of a truck with special nuclear material inside. Through collaboration with Decision Sciences International Corporation, facilitated by the Feynman Center, this Los Alamos technology was commercialized for use at ports of entry.

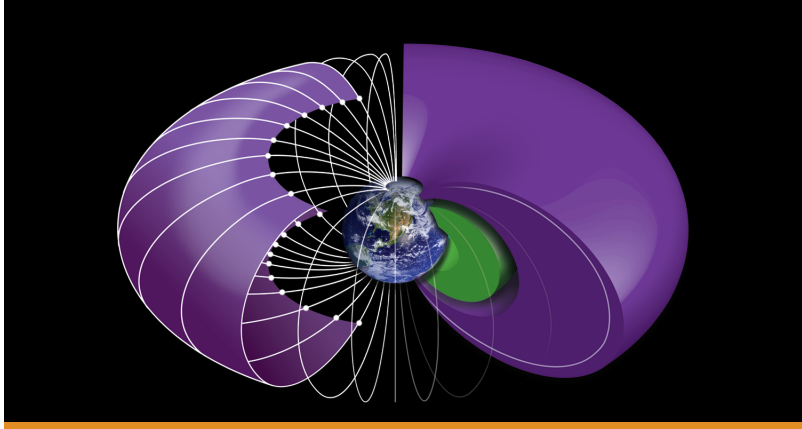
Strategic Investments in Our Scientific Foundation

The greatest science breakthroughs come from approaching difficult problems in revolutionary and interdisciplinary ways. Los Alamos' national security missions require an effective, flexible, forward-looking multidisciplinary approach to solve some of the nation's toughest science and engineering challenges. Our flexibility comes from four key capability areas or "Science Pillars" that are fundamental to our missions. These pillars are sustained by our scientific expertise and our unique experimental and computational facilities. These same strengths also define our role in broader security missions, allow us to approach difficult problems in a new fashion, and face national challenges we cannot yet imagine. The four Los Alamos Science Pillars are Materials for the Future; Science of Signatures; Nuclear and Particle Futures; and Integrating Information, Science, and Technology for Prediction.

Materials for the Future

Exploring the physics, chemistry, and metallurgy of materials has been a primary focus of Los Alamos since its founding. Advances in understanding nuclear materials, developing insensitive high explosives, and creating materials for fusion reactions, radiation casings, and neutron sources have enabled a safe, secure, and effective nuclear weapons deterrent. As the Laboratory's missions have evolved to include threat reduction, defense, energy, and other national challenges, the science of materials has expanded.

Through the exploration of materials, Los Alamos pursues the discovery science and engineering required to establish design principles, synthesis pathways, and manufacturing processes for advanced and new materials to intentionally control functionality relevant to our national security mission. We predict and control functionality through forefront science and engineering in the areas of materials defects and interfaces, extreme environments and novel diagnostics, and emergent phenomena.

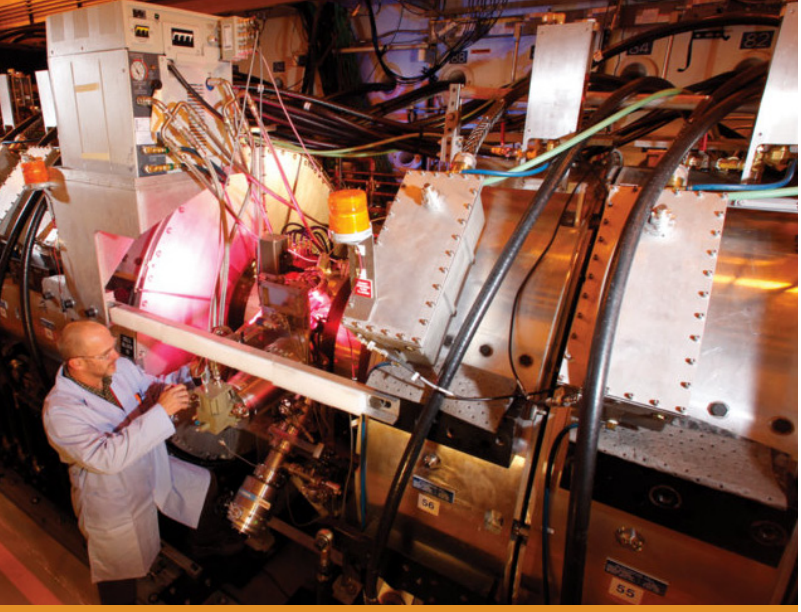


Los Alamos' participation on NASA's Van Allen Probes mission is helping to discover the natural processes responsible for the Earth's radiation belts. Together with DOE's Nuclear Detonation Detection System satellites, the mission provides critical inputs to Los Alamos' Dynamic Radiation Environment Assimilation Model (DREAM), which predicts hazardous space weather and allows satellite operators to defend against dangerous space storms. SoS capabilities such as DREAM support space situational awareness by assimilating disparate, sparse data streams from space environment instruments to provide space weather in almost any location of the Earth's space environment.

Science of Signatures (SoS)

SoS consists of critical science capabilities used to detect, measure, and analyze the unique signatures or "fingerprints" of extraordinarily complex national security threats. At Los Alamos, we apply this science to solving problems as they relate to global security, nuclear defense, energy, climate, and health. We characterize measures, signals, and properties in complex systems to detect change; predict systems behavior across scales in space and time; and assess impacts to the system. Our expertise in this area allows us to provide credibility and defensibility for key national and homeland security decisions.

Los Alamos scientists load a vertical electrophoresis gel, used to separate proteins and small molecules. This technique can help develop better methods to detect pathogens, potentially aiding in the timely detection of disease. There is a recognized national need for advanced biological signature technologies for biosurveillance. Biosurveillance is a key component of the Laboratory's biosecurity strategy.



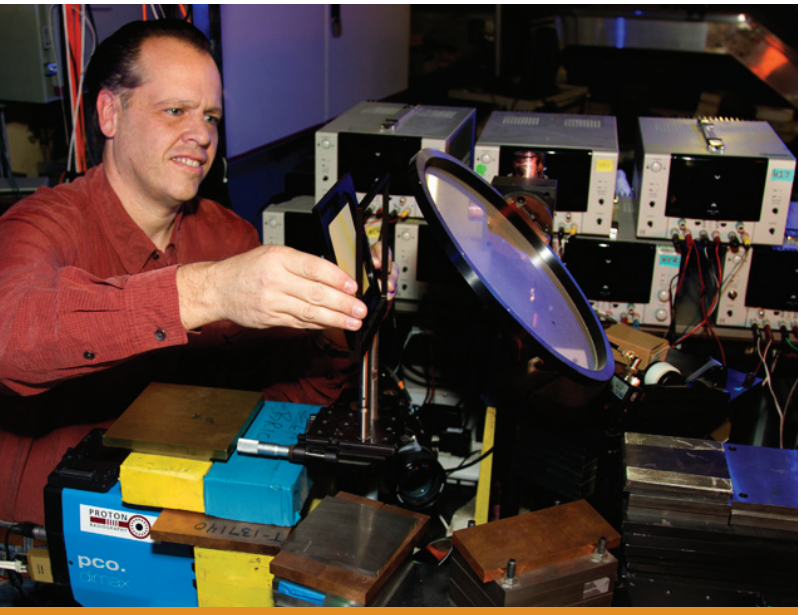
DARHT allows Los Alamos and Lawrence Livermore National Laboratory scientists to study the three-dimensional implosions of mock nuclear weapon primaries by producing x-ray images of nonnuclear hydrodynamic tests. DARHT's first axis produces a single image while the world-class second axis generates a timed sequence of four images. These images provide a glimpse into dynamically unfolding events during a critical point of a nuclear detonation, yielding far more information than can be obtained with a single image.

Nuclear and Particle Futures (NPF)

Our NFP capabilities support crucial fundamental research and technological developments to successfully advance stockpile stewardship and understand the nuclear component of threat reduction. NPF capabilities include our LANSCE, Trident, and Dual-Axis Radiographic Hydrodynamic Test (DARHT) facilities. These capabilities are enabled by our expertise in accelerators and high-energy density physics, leadership in critical assembly work (performed at the Nevada National Security Site), proficiency in nuclear engineering, and extensive expertise in nuclear experiment, theory, and simulation. NPF also advances our fundamental understanding of nuclear physics, high-energy physics, and fusion-energy science. NPF research directly contributes to new methods supporting forensics, special nuclear material detection, and counterproliferation.

Integrating Information, Science, and Technology (IS&T) for Prediction

IS&T focuses on those foundational capabilities that are Los Alamos' strength in producing validated integrated predictive simulations. Initially developed for stockpile stewardship, this predictive capability is used for many Los Alamos efforts and missions. We have developed these efforts through incorporating insights from experiment, theory and modeling, and algorithm development to take advantage of our strength in high-performance computing. Through IS&T, Los Alamos is making important contributions in complex system behavior prediction, materials performance, situational awareness, energy-climate impacts, and energy infrastructure. Our IS&T focus includes data science at scale, computational co-design, and complex network science.



A Los Alamos scientist replaces the proton-to-light converting scintillator in preparation for a dynamic experiment at the pRad Facility.

Leading Science at Extremes

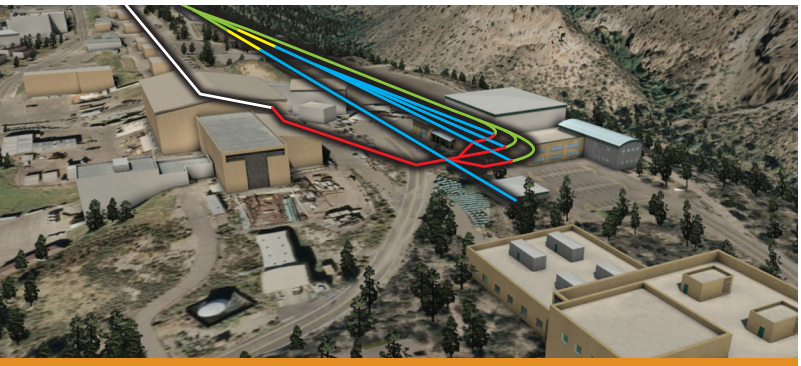
A nuclear weapon explosion involves complex and synergistic natural physical processes, including chemistry, physics, and nuclear and thermonuclear reactions, which are the energy source of the Sun

Roadrunner, the world's first petascale computer, was installed at Los Alamos in 2008 and supported weapons calculations for five years. (In computing, petascale refers to a computer system capable of reaching performance in excess of one petaFLOP, i.e., one quadrillion floating-point operations per second.) The next large-scale DOE/NNSA computing system on the path to exascale is Trinity. (Exascale capacity represents a thousandfold increase over Roadrunner.) Trinity is scheduled for installation at Los Alamos in FY15 and will be jointly managed by Los Alamos and Sandia national laboratories. It is expected to serve the NNSA laboratories through the end of the decade.

and stars. Our mission-driven science intrinsically pushes scientific frontiers. We lead transformative science at the extremes of physical conditions or scale, through experimental capabilities and computational modeling and simulation.

Materials at Extreme Conditions

Materials functionality by design and predicting the behavior of materials in dynamic extremes are achieved by integrating experimental data and theory through predictive models and capabilities. Leadership in these areas, as well as materials synthesis and advanced manufacturing, is key to current and future missions.



MaRIE is Los Alamos' proposed flagship experimental facility intended to revolutionize materials in extremes by conquering the micron frontier (the gap between understanding a material on the atomic scale and validating its performance on a bulk scale). MaRIE will advance the transition from observation and validation of materials performance to prediction and control of materials functionality to meet mission requirements.

Materials properties, characterization, and qualification in extreme or adverse conditions are fundamental for stockpile stewardship. Advances in these areas will enable the future of additive manufacturing for the weapons enterprise, potentially leading to more reliable and efficient component production and enhanced nuclear safety. The Los Alamos proposed Matter-Radiation Interactions in Extremes (MaRIE) experimental facility will provide the venue for tackling such issues and will help attract the materials technical workforce needed to respond to stockpile challenges of the future.

High Performance Computing and Computational Science

From the advent of computing, Los Alamos has been a leader in finding creative ways to apply state-of-the-art computing to national security imperatives. Today, we remain a world leader in high-performance computing and computational science for national security challenges. Los Alamos leads in providing the computing environment, systems, and technologies that support the evolution to exascale-class computing. We must also lead with application and workforce readiness to take advantage of exascale and beyond computing systems and technologies.

Ensuring a Vital Future Workforce

Our talent provides our most important asset for delivering on current missions and ensuring our responsive readiness. Our key strategies for sustaining top talent today and into the future are to:

- Position the Laboratory to compete for and attract world-class talent;
- Develop and mentor next-generation workforce and leadership talent; and
- Position the Laboratory as one of the best places to work.

We are creating a strong sense of community and fulfillment with a vision for an exciting future. This focus on people increasingly will permeate all of our efforts—from the first impressions we strive for, through selection and hiring, bringing employees on board, and then developing and managing people throughout their careers at Los Alamos.

Each summer, the Laboratory hosts more than 1,000 undergraduate and graduate students from around the nation and the world. Students have opportunities to perform research relevant to their fields of study. In this photo, the student is working to improve the production of commodity chemicals through bio-based methods using algae or bacteria.

Attracting World-Class Talent

At Los Alamos, we draw upon physicists, materials scientists, chemists, computer scientists, biologists, earth scientists, space scientists, engineers, mathematicians, and numerous other disciplines, supported by our operational and professional staff, to solve pressing national security science problems. To position ourselves to attract world-class talent across all job categories, we will develop and implement a multiyear strategy that delivers the right workforce now and into the future. We proactively recruit candidates from the nation's best colleges and universities and from industry and government with an emphasis on strategic hires to support capabilities important to current and future missions.

We will strengthen the Laboratory's diversity profile by actively promoting diversity in all its dimensions, strengthening diverse science, technology, engineering, and mathematics (STEM) talent pipelines; integrating diversity into all our recruiting and selection decisions; and cultivating an inclusive workplace where differences are valued.

Next-Generation Workforce and Leadership Talent

To develop strong leaders, managers, and technical and professional employees, we will strengthen ongoing talent development programs.

We will enrich the student and postdoc experience through research opportunities, effective mentoring, and expanded technical networking. This process builds upon already robust student and postdoc programs that facilitate professional development opportunities for early career scientists and engineers.

The Laboratory's postdoc program continues to bolster our scientific and technical vitality by facilitating the sharing of new ideas and approaches from universities and other organizations all over the world. Because postdoc conversions comprise a significant percentage (nearly 70%) of all technical hires, a strong and vital postdoc program is essential to our success.

We promote science and education through research centers and student programs via our National Security Education Center (NSEC). NSEC serves as a hub to students and visiting professors from around the world and Laboratory technical staff. Participants engage in specialized education, training opportunities, and the development of exciting projects on everything from monitoring the structural health of wind-turbine blades to developing new computer architectures for handling very large datasets. Key programs are housed within NSEC:

- Engineering Institute, in conjunction with the University of California, San Diego (UCSD);
- Information Science and Technology Institute, in conjunction with UC, Santa Cruz;
- Institute for Geophysics, Planetary Physics, and Signatures;
- Materials Science Institute, in conjunction with UC, Davis, and UC, Santa Barbara;
- Seaborg Institute; and
- Center for Nonlinear Studies.

Our annual succession-planning process identifies incumbent and high-potential leadership candidates. We will cultivate leadership skills through formal programs that develop, assess, and mentor current and potential leaders across the institution.We invest in ongoing managerial leadership development at all levels of the Laboratory through institutionally sponsored development programs, such as the Director's Leadership Development Program, formal and informal mentoring and coaching, and action-learning assignments.

The Laboratory as a Best Place to Work

Los Alamos draws talent that is energized by compelling missions, fascinating multidisciplinary teaming opportunities, and access to one-of-a-kind experimental and computational capabilities. These aspects differentiate the Laboratory as a great place to work. We must continue to work hard to ensure our workplace and culture attract and retain the workforce we need to meet evolving national security needs.

This engineer, a summer student at the Engineering Institute, tests a new proposed interface between the human nervous system and a distributed sensor network with hopes of developing new techniques to enable human-machine cooperation.

There are multiple factors that contribute to a best national laboratory workplace. They include ensuring that we have the scientific tools to support compelling science, improving and modernizing the quality of the work environment, keeping pace with the availability of data and information services required for modern science, and providing modern technology and communication services. To sustain a motivated and engaged workforce, we must also create a positive, inclusive, and supportive work culture and invigorate our internal communications practices and tools.

The Engineering Institute

Engineering is an integral part of every science and national security program at Los Alamos. A vibrant engineering science foundation contributes to our leadership in innovative products that benefit society and advance economic competitiveness. To strengthen our engineering pipeline, Los Alamos collaborates with UCSD's Jacobs School of Engineering to operate our Engineering Institute, which gives students and early-career employees opportunities to conduct mission-driven, multidisciplinary engineering research. The Engineering Institute also serves to retain mid-career staff members who serve as instructors and advisors to participants.

Enabling mission delivery through next-generation facilities, infrastructure, and operational excellence

In order to deliver our mission solutions and world-class science and engineering, we must be a Laboratory that works seamlessly and we must lead in environmental stewardship and social responsibility. Our key operational strategies are to:

- Demonstrate leadership in environmental stewardship, commitment to sustainability, and social responsibility;
- Transform our infrastructure to enable scientific breakthroughs;
- Drive productivity and innovation in all aspects of operations, business systems, and information systems; and
- Protect our people, our assets, and our information.

A top environmental priority of the State of New Mexico and DOE is the removal of 3,706 cubic meters of transuranic waste stored above ground at the Laboratory through the 3706 TRU Waste Campaign. Los Alamos has exceeded its goal each year of this campaign, shipping more than 3,000 cubic meters of waste by the end of 2013.

Environmental Stewardship and Social Responsibility

The Los Alamos *Long-Term Strategy for Environmental Stewardship & Sustainability* provides an integrated plan for environmental sustainability that encompasses environmental cleanup and restoration from past activities, control of present work and conditions, and a sustainable future. We demonstrate our social responsibility in the Northern New Mexico region by diligently managing environmental work and by supporting regional priorities such as economic development and STEM education through our Community Commitment Plan (CCP).

Environmental Cleanup and Restoration

We will continue to work closely with DOE and the New Mexico Environment Department (NMED) to follow the requirements set out in the Compliance Order on Consent and the Framework Agreement, which provides direction on cleanup of historic legacy waste sites and protection of Northern New Mexico's water resources. The Laboratory investigates locations where hazardous chemical or radioactive materials may be present, stabilizes or excavates material and sediments, samples for known and unexpected contaminants, and transports by waste type to appropriate disposal facilities. Of the sites originally identified for action, half have been remediated to date, with significant work still ahead of us.

Controlling Present Conditions

Our Environmental Management System is certified under the International Organization for Standardization's ISO-14001 standard. We actively identify and control hazards; minimize impacts to air, water and land; implement pollution

prevention programs; and protect biological and cultural resources. We work with the U.S. Environmental Protection Agency, NNSA, and NMED to demonstrate compliance with our existing environmental and radiological and hazardous waste operating permits.

Sustainable Future

The Laboratory's science and technology innovations contribute to a cleaner environment and greater sustainability both here and elsewhere. We implement technologies and conduct operations to support long-term environmental stewardship and sustainability. We conserve water and protect the water supply, conserve energy and increase the use of renewable energy, mitigate secondary impacts from climate change such as habitat degradation, and protect environmental and human health.

Social Responsibility and Regional Engagement

According to the International Organization for Standardization, social responsibility—or a company's relationship to the society and environment in which it operates—is "a critical factor in the ability to continue to operate effectively." We have placed increasing emphasis on cultivating a positive relationship with our neighbors and surrounding communities. Through effective and honest communication, we will continue to build trust and strengthen relationships with our communities and stakeholders. The Laboratory's CCP is a cornerstone of our regional engagement. Between 2006 and 2014, LANS, LLC invested approximately $30 million in Northern New Mexico to support regional priorities, including economic development and STEM education.

The Radiological Laboratory/Utility/Office Building (RLUOB) has received both the DOE Secretary's Award for Project Management Excellence and the DOE EStar award for environmental sustainability. RLUOB, our newest facility supporting our Plutonium Strategy, consists of 19,500 sq. ft. of radiological laboratory space, office space for 350 employees, and emergency response capabilities.

Transform Our Infrastructure

To enable mission delivery and world-class science and engineering for the future, Los Alamos created the *Long-Range Infrastructure Development Plan*, which lays out multiyear strategies for infrastructure revitalization.

This plan proposes the actions needed for mission-centric utility and facility upgrades, footprint reduction initiatives, energy and water efficiency enhancements, facility and infrastructure asset management, and other facility modernization needs. The plan calls for providing actinide science and manufacturing infrastructure to meet national security mission needs and constructing scientific facilities to support cutting-edge experimental work. These upgrades are necessary so that we can continue to meet our current and future national security missions.

We also will continue to modernize our information technology infrastructure and systems to deliver reliable technology solutions and increase the Laboratory's workforce productivity.

Drive Operational Productivity and Innovation

We depend on the trust and confidence of our stakeholders to execute our national security missions. Our sponsors must be able to count on our excellence in quality and stable, reliable operations. To deliver on our commitments and serve the nation, we must continuously improve cost effectiveness, efficiency, and accountability in all aspects of our operations.

We must be just as creative in how we conduct operations as we are in our missions and science. We will continue to implement modern and integrated management processes, tools, and practices to seamlessly meet the needs of employees, enhance work productivity and efficiency, and manage costs.

At the same time, our high-hazard work demands that we manage risk diligently. We will continue to collaborate with customers and regulators to manage risk responsibly, work productively, and meet mission deliverables.

We will deliver construction projects in accordance with the budget profile, scope, cost, schedule, quality, and risk negotiated with program sponsors or partners. We provide qualified project managers to lead integrated project teams in support of various types of projects across the Laboratory. Our integrated project teams bring together personnel specializing in project estimating, project controls, construction management, and information technology, as well as specialists in engineering, quality assurance, safety, procurement, and document control and records management. These teams make it possible to successfully plan, execute, and manage projects for the Laboratory.

We will continue to apply our Lean Six Sigma (LSS) expertise to help gain economies of scale, streamline process flows, identify cross-organizational efficiencies, and find operational synergies with other laboratories. We use approaches such as LSS to ensure quality, improve continuously, and create value for customers and employees in all aspects of Laboratory operations.

Protect Our People, Assets, and Information

Safety and security remain significant priorities for the Laboratory. To succeed in our missions, our people, assets, and information must be safe and secure. We will promote a healthy employee population, anticipate and mitigate significant workplace health and safety risks, and enhance our safety margins. We will continue to strengthen management and employee participation in wellness, safety, and security.

To support our national security missions, we will sustain robust and resilient physical security infrastructure and safeguards that protect U.S. government assets entrusted to the Laboratory. Our top priorities include the protection of personnel, property, special and alternate nuclear materials, and classified matter. We ensure the accountability of special nuclear materials through implementation of a fully compliant material control and accountability program. We provide performance assurance through rigorous testing and oversight.

We deliver a secure cyber network that is reliable, agile, and resilient and where risks are effectively mitigated. Information security will continue to be woven seamlessly into every aspect of Laboratory information technology.

The Laboratory's protective force consists of highly skilled, trained, and motivated security officers who stay ready for action with a rigorous regimen of instruction, training exercises, firearms qualifications, and physical fitness. This officer participates in a protective force exercise.

Conclusions and Acknowledgments

This plan is a living document and a guide for action. Our management is committed to implement the strategies in this plan and to periodically review and modify it to align with future national security needs and evolving customer requirements. This plan will allow us to evolve our mission strategies and drive our priorities and future sustainability. We will continuously improve this planning process to ensure mission success now and into the future.

Special thanks are extended to Los Alamos' 2013 Strategic Planning working group and to the Principal Associate Directors and their teams for their dedicated work in developing this plan. We would also like to thank the communication teams and the Director's staff for their significant effort in publishing this plan.

Front/back cover images:

- Stealth Bomber, which features low-observable stealth technology and is able to deploy both conventional and nuclear weapons.
- As part of the U.S. Nuclear Detonation Detection System, global positioning system satellites carry sensing payloads developed and built at Los Alamos and Sandia national laboratories for treaty verification.
- A conceptual representation of nuclear scattering upon interaction with a particle beam.
- DARHT accelerator, which provides very intense electron beams using electrical energy from a high-voltage, pulsed-power system for experiments supporting stockpile stewardship.
- Photovoltaic solar collectors associated with a Laboratory "Smart House" project, demonstrating smart grid technology.
- Climate and ocean modeling image from the Laboratory's Climate Ocean and Sea Ice Modeling project.
- Multiplexed Photonic Doppler Velocimetry, a novel optical diagnostic, measured the motion of a plutonium surface along more than 100 rays, providing orders-of-magnitude more data than similar past experiments. This experiment was part of a Laboratory subcritical plutonium experiment with the Gemini series at the underground U1a facility at the Nevada National Security Site.
- The 375 boxline located in the Los Alamos TA-54 Area G facility, used for processing radioactive hazardous waste and preparing it for shipment offsite. This boxline facility was constructed to ensure the largest waste boxes could be safely processed.

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