2019 Strategic Framework
National Nuclear Security Administration
Laboratory and Site-Directed Research and Development

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The Laboratory and Site-Directed Research and Development programs (hereafter referred to as *the Programs*) were established in 1991 and 2002, respectively, by Congress as bold initiatives to ensure scientific and technical vitality at the U.S. Department of Energy (DOE) laboratories. At Lawrence Livermore, Los Alamos, and Sandia National Laboratories, the Laboratory Directed Research and Development (LDRD) programs are important sources of internal investment in science and technology for the future. The Nevada National Security Site (NNSS) conducts applied science and technology research and development through the congressionally authorized Site-Directed Research and Development (SDRD) program. LDRD and SDRD programs across the different laboratories and sites encompass a wide range of interests, fields, and concentrations, providing multi-programmatic benefits to many agencies and organizations.

Vision Statement

The LDRD and SDRD programs are part of the foundation of the National Nuclear Security Administration's (NNSA) strategy for developing science and technology tools and capabilities to meet future national security challenges.

Objectives

According to DOE Order 413.2C, the Programs serve to

- maintain the scientific and technical vitality of the laboratories,
- enhance the laboratories' ability to address current and future DOE/NNSA missions,
- foster creativity and stimulate exploration of forefront areas of science and technology,
- serve as a proving ground for new concepts in research and development, and
- support high-risk, potentially high-value research and development.

Strategy to Achieve Objectives

NNSA laboratories and NNSS have a shared mission to solve national security challenges by leveraging scientific and engineering excellence. Their individual strategic plans align with priorities set by DOE, NNSA, and key relevant national strategy guidance documents, such as the 2018 *Nuclear Posture Review*, which establish U.S. nuclear weapons policies, missions, capabilities, and forces. Specifically, the mission of the DOE is to ensure U.S. security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science, technology, and engineering solutions. Within its national security missions, NNSA maintains and enhances the safety, security, and effectiveness of the U.S.

nuclear weapons stockpile without nuclear explosive testing, works to reduce the global danger from weapons of mass destruction, and responds to nuclear, chemical, biological, and radiological emergencies in the U.S. and abroad.

Through their individual strategic planning processes, NNSA laboratories and NNSS use the Programs to seed their capability-bases and scientific workforces to prepare for emerging national security challenges, thereby achieving the NNSA mission and supporting the 2018 *Nuclear Posture Review*. Strategic LDRD and SDRD investments align with institutional priorities. They are determined by systematic annual planning, staff-initiated proposals, and rigorous peer-review-based selection processes. Annual plans that describe the Programs' investment strategies are submitted to the NNSA field offices for concurrence. Whereas the strength of the Programs lies in their nature, which is laboratory- and site-directed and internally competitive, the impact of the Programs is seen in their combined application to current and future DOE and NNSA challenges.

Insight into how the Programs impact NNSA is derived from quantitative metrics as well as from independent assessments. Metrics and analyses are used for the continuous improvement of the Programs and are published in their annual reports, which include information on strategic priorities, program structure, and funded projects (available online at tri-lab.lanl.gov).

The Programs are committed to developing capabilities to address current and future national security challenges, to attract and develop world-class technical talent, and to continuously follow best practices.

Addressing Current and Future National Security Challenges

By creating and maintaining a solid science and technology base, the Programs enable NNSA to create new ways of responding to national security challenges. The 2018 *Nuclear Posture Review* identified several important challenges, and the Programs play an important role in addressing these challenges.

Challenge: *Provide an agile, flexible, and effective nuclear deterrent.*
As noted in the 2018 *Nuclear Posture Review*, "Our nuclear deterrent is nearing a crossroads. To date, we have preserved this deterrent by extending the lifespan of legacy nuclear forces and infrastructure—in many cases for decades beyond what was originally intended. These systems will not remain viable indefinitely. In fact, we are now at a point where we must concurrently modernize the entire nuclear triad and the infrastructure that enables its effectiveness."

> ***Programs' role:*** To support the nuclear deterrence mission, the Programs invest in research and development to enhance the fundamental understanding of current aging nuclear weapons systems. In this way, the Programs provide the capabilities to help ensure the viability of the stockpile, while creating the science and technology base necessary to counter evolving world threats that drive new requirements for weapons performance. The Programs enable an agile, flexible, and effective stockpile driven by emerging national requirements and build agility not only for surveillance, assessment, and sustainment, but also for exploring new concepts and options. This ability requires

fundamental and applied research across a breadth of disciplines, including advanced materials and manufacturing; nuclear and radiation science and engineering; high-energy-density physics, astrophysics, and accelerators; microelectronics and electronic systems; sensing and measurement techniques; and high-performance modeling and simulation to understand and predict complex systems performance and to support agile weapon development.

Challenge: *Protect against all weapons of mass destruction threats.*
Reducing the global dangers posed by weapons of mass destruction requires advanced capabilities to prevent, counter, and respond to nuclear, radiological, chemical, and biological proliferation, as well as to terrorism threats and incidents worldwide. According to the 2018 *Nuclear Posture Review*, "The most effective way to reduce the risk of nuclear terrorism is to secure nuclear weapons and materials at their sources."

Programs' role: The Programs support this challenge with research and development to advance nonproliferation, counterterrorism, counter-proliferation, and emergency response capabilities across the entire threat spectrum from intent through crisis response. NNSA's central role in this challenge requires the discovery of signatures that enable the detection and characterization of radiological, nuclear, chemical, biological, and explosive agents; revolutionary ground and space-based measurement techniques; and data science at an unprecedented scale.

Challenge: *Deter and defend against threats in multiple domains.*
In addition to increasing the salience of their nuclear forces, U.S. adversaries have engaged in challenging behavior in multiple venues, including outer space and cyberspace. The 2018 *Nuclear Posture Review* acknowledges that "[t]here now exist an unprecedented range and mix of threats, including major conventional, chemical, biological, nuclear, space, and cyber threats, and violent non-state actors. These developments have produced increased uncertainty and risk." There is a natural and increasingly significant synergy between the nuclear weapons mission and the nation's broader global security missions. The nation benefits when NNSA laboratories and NNSS apply their technical capabilities to these complex challenges.

Programs' role: The Programs support this challenge with research and development to improve the security and resilience of the nation and its critical infrastructure from cyberattack, electromagnetic pulses, robotic and drone attacks, biological agents, and natural hazards. The Programs also explore solutions to emerging security challenges associated with technology surprise in space, cyberspace, bioscience, bioengineering, and other military domains. Investments in the capabilities required for the first two challenges are relevant here as well.

Challenge: *Strengthen our energy and environmental national security.*
Energy and environmental security are critical components of our national security. The security and economic viability of the nation rests on the safe, affordable, and reliable delivery of U.S. energy resources across interdependent national and global networks of electricity, fuel, and water. Complex interactions among biological and earth systems help to determine U.S. security across energy and water infrastructures. Geoscience and atmospheric science play important

roles in NNSA missions regarding the fate and transport of radiochemical compounds through environmental systems and the detection of underground, underwater, and above-ground nuclear tests. Innovative and transformative scientific and technological solutions are required to address these energy and environmental security challenges facing the nation in the 21st century.

> ***Programs' role***: The Programs work at the interface of biology, earth sciences, engineering, manufacturing, and the physical sciences to address the DOE's energy and environmental security missions with cross-cutting initiatives that concurrently benefit core NNSA missions.

Attracting and Developing a World-Class Technical Workforce

The Programs help the nation remain postured to address current and emerging mission challenges by recruiting, training, and retaining tomorrow's technical workforce in essential areas of expertise critical to mission delivery. Success in the national security enterprise depends on a highly capable workforce with specialized skills in a broad array of technical fields. In fact, the 2018 *Nuclear Posture Review* recognizes that "the scientists, engineers, and production personnel of the nuclear infrastructure support nuclear arms control, threat reduction, naval nuclear propulsion, non-proliferation efforts, assessments of foreign nuclear weapons programs, nuclear counterterrorism, and emergency response." Cutting-edge research and development across the technical spectrum attracts cutting-edge talent.

Principles and Best Practices for Carrying Out the LDRD and SDRD Programs

Published calls for proposals provide top-down guidance on national security needs and priorities that lead to bottom-up, staff-initiated proposals. Projects are selected based on scientific promise, mission relevance, and compliance with legislation and executive order. Proposals undergo rigorous, independent peer review for both technical excellence and national security mission relevance. Evaluation criteria include innovation and creativity, potential scientific impact, viability of the research approach, qualifications of the team, and potential impact on NNSA missions. The selection processes are consistent with the best practices established by the National Science Foundation, the National Institutes of Health, and the DOE's Office of Science. The NNSA field offices verify every project for mission relevance and regulatory compliance, approve the strategic approach articulated in annual program plans, and review all project outcomes. Every DOE mission area contributes to and benefits from the Programs' investments.

Best practices for projects are shared among NNSA laboratories and NNSS, as facilitated by the NNSA LDRD and SDRD Working Group. Shared principles include annual reporting to the DOE and NNSA, independent peer review within and beyond the site and laboratories, and a graded level of oversight based on project size.

The LDRD and SDRD Programs Are Essential for Our National Security

NNSA laboratories and NNSS rely on the Programs for innovation and transformation, delivering technical solutions that reduce the risk of technology surprise and prepare America for an uncertain future.

For contact information, metrics of success, project highlights, and more, go to tri-lab.lanl.gov.

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