Sandia National Laboratories

SAND2020-1450R

# Global Security

## 5-10 Year Strategy

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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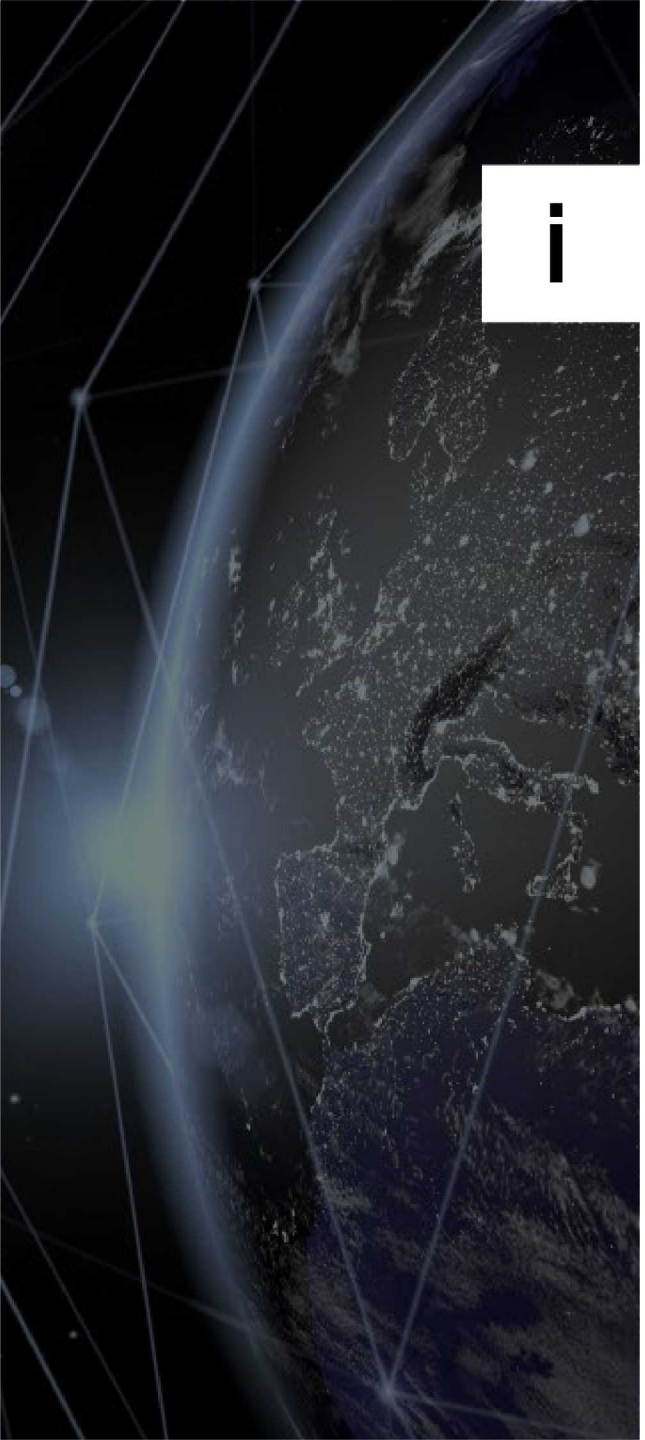

# Message from the Associate Labs Director

**Sandia National Laboratories strives to provide exceptional service in the national interest.** To ensure the Lab is equipped to meet future national security challenges, Sandia has identified seven Labs-level strategic priorities to guide programmatic activities over the course of the next three decades. Four of these priorities directly align to Global Security enduring missions:

- Develop transformational technical solutions to detect threats to national security (global monitoring)
- Anticipate threats to national security through intelligence science (preventing proliferation)
- Maintain an agile and effective nuclear deterrent (nuclear weapon security)
- Invent and demonstrate pathfinder systems to address threats (global monitoring, preventing proliferation, and nuclear weapon security)

**While the Labs' priorities are based on a 30-year horizon, the division's strategic plan is focused on defining Global Security's future over the next 5-10 years.** Utilizing a highly interactive approach, Global Security engaged the associate lab director, center directors and senior managers to develop a strategic plan with imperatives that propel us forward in attaining these aspirational lab priorities.

The strategic plan equips Global Security for success by setting direction and priorities, driving operational excellence, emphasizing the areas of need for innovation, and integrating the division through teaming.

**Global Security's strategy is our basis for moving into the future**. Without being overly prescriptive, it encourages collaboration and consistency, emphasizes the area of need for technical capacity and innovation, and provides guiding principles for advancing Global Security's programs. Global Security's underlying capabilities and relationships are vital to this strategy and ensure the nation is best positioned to respond to unanticipated national security events today and into the future.

**As our operating environments become more contested, threats more diversified, and information and technology more accessible, it is critical the US is properly equipped to meet future national security challenges** . Sandia must continue to lead the nation in developing the necessary capabilities to support the United States' ability to monitor, defend against an evolving range of threats, and devise innovative solutions for the unanswered technological challenges of tomorrow.

**Doug Bruder**
ASSOCIATE LABS DIRECTOR, GLOBAL SECURITY

# OVERVIEW

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**Global Security delivers innovative engineering solutions to protect the nation from strategic threats at home and abroad.** Global Security programs focus on developing and implementing technical solutions to address global security challenges through three enduring missions:

### Global Monitoring
Nuclear proliferation and detonation detection, missile warning, and space control and protection

### Preventing Proliferation
Detect, prevent, counter, and respond to weapons of mass destruction (WMD) acquisition and use posed by state and non-state actors

### Nuclear Weapon Security
Next-generation security architectures that are effective for emerging threats and alternative deployments

**Global Security is facing an increasingly complex national security environment**, rapidly changing technical landscape, and increasing pressure through privatized development and manufacturing of capabilities. To remain relevant, Global Security must continue to deliver exceptional service in the national interest while simultaneously prioritizing and focusing investment in innovations with the greatest impact to its mission space.

**To that end, the Global Security's leadership has embarked on a 5-10 year strategic planning process for greater alignment with lab-level strategic priorities**, fluctuating customer needs, and a shifting national security landscape while continuing to deliver on Global Security's three enduring missions.

**The Global Security Division has four primary motives for creating a division-level strategic plan:**

- Set direction and priorities through strategic thinking in the division's mission areas.
- Drive operational excellence in mission areas and create tools to effectively manage the portfolio of work.
- Integrate the division through teaming and involve the division broadly.
- Allocate resources to key activities and achieve a better understanding of the impact on Global Security's priorities.

# Strategic Initiatives



**Global Security used a holistic approach to guide the strategic planning process**. To better understand the external environment and key factors impacting Global Security's future, this process encompassed gathering input from a wide array of internal and external sources, conducting market research and an external landscape analysis, and facilitating focused discussions on cutting-edge Global Security topics with a diverse range of staff and leadership.

**Informed through this process, the leadership identified four strategic initiatives to direct and better equip Global Security for success**. The strategic initiatives include two mission drivers that will shape how these enduring missions evolve over the next 5-10 years: All Global Security missions will be conducted in more contested environments (space, air, sea, land, and cyber) in the future and must also enable timely and effective decision making during national security crises. Additionally, two mission enablers were also identified that strategically support the execution of the missions: Global Security will deploy outstanding engineering, science, and technology and engage the broader Sandia community to advance its enduring missions.

**While this strategy encompasses our primary areas of focus, we expect that innovative new activities outside the current framework will occur within the Global Security portfolio as new opportunities arise** Efforts outside this framework may evolve into greater areas of focus in the future and will be captured in a strategy update. Global Security's strategic plan is intended to be a living document that will be updated on an annual and as-needed basis.

## FOUR STRATEGIC INITIATIVES

Global Security will focus on four strategic initiatives to direct investment and resources to enduring mission activities:

### Mission Drivers

- Conduct our Global Security missions in contested environments
- Enable timely and effective decision making during national security crises

### Mission Enablers

- Deploy outstanding engineering, science, and technology to our Global Security missions
- Engage the broader Sandia community

# Global Security Framework

## ENDURING MISSIONS

MISSION DRIVERS


MISSION ENABLERS

# ENDURING MISSION
## Global Monitoring

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*Nuclear proliferation and detonation detection, missile warning, and space control and protection.*

**Sandia's first global monitoring efforts date back to the late 1950s after the US-USSR moratorium on atmospheric testing.** The Advanced Research Projects Agency funded research at Sandia in 1959 to verify Soviet compliance with the moratorium on nuclear testing. Under the code name VELA, this first verification program sought detection of nuclear testing in space and in the atmosphere. Today, Sandia develops instrumentation and serves as the system integrator (integrating Los Alamos National Laboratory developed instrumentation) for United States Nuclear Detonation Detection System (USNDS) payloads that are hosted on all Global Positioning System satellites.

**Sandia also supports missions for geophysical monitoring of nuclear detonations and debris and signature collection for nuclear characterization and attribution**. In addition, Sandia advances US government capabilities for missile nuclear warning.



**Current global monitoring efforts focus on space and ground-based systems detection of nuclear detonations**. These sophisticated and costly detection systems often are single-purpose and rely on rare event satellite detection methods signaling a nuclear event has occurred. With improvements in imagery and the increased availability of data from nongovernmental agencies, the sheer availability and amount of information has made overall global monitoring activities more challenging. Future detection activities will need to incorporate and process a vast array of information based on open and multi-source domains with meaningful analysis and timely reporting of aggregate data. Additionally, detection methods will need to consider areas of efficiencies, expand monitoring capabilities from single to multipurpose systems, and transition from dedicated server ground-processing to cloud -based processing methods.

**Global Security's leadership has identified three objectives to continue to advance global monitoring as an enduring mission:**

1. Develop a multimission platform for next-generation transient event detection.
   - Develop multimission collection systems, analysis capabilities, and reporting mechanisms that can meet missile warning and proliferation monitoring needs.
   - Reduce payload or deployed sensor/system footprint to enable diverse deployment on multiple platforms.
2. Define Sandia's value proposition in space control, situational awareness, and system trust.
   - Increase our adversary's cost or effort to hold the US at risk by improving system resilience and subsystem hardness.
   - Develop capability for improved tip and cue from other data and information for rapid response to threats and opportunities.
3. Standardize and modernize Sandia's ground processing architectures of the future.
   - Enable the US Government to rapidly process data from multiple sensors in contested locations while maintaining data integrity.
   - Further the integration of software and systems engineering to maximize responsiveness and confidence in our deployed systems.

## MISSION OBJECTIVES

- Develop a multimission platform for next-generation transient event detection
- Define Sandia's value proposition in space control, situational awareness, and system trust
- Standardize and modernize Sandia's ground processing architectures of the future

## MISSION OBJECTIVE HIGHLIGHT

STARCS MISSION CAMPAIGN

*Science and Technology Advancing Resilience for Contested Space (STARCS) focuses on preserving US capabilities in space by ensuring the survival of mission-critical hardware from environmental effects and the ability to operate through an adversary attack.*

# ENDURING MISSION
## Preventing Proliferation

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*Detect, prevent, counter, and respond to WMD acquisition and use posed by state and non state actors.*

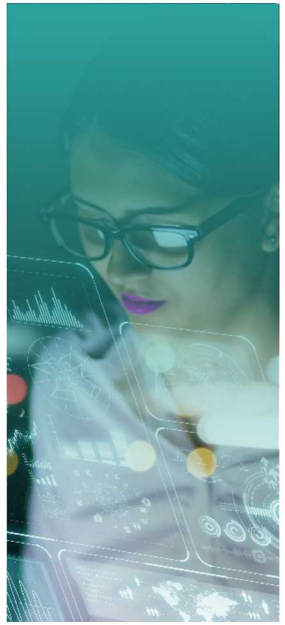
**Preventing proliferation — developing ways to keep nuclear materials and WMD secure and out of the hands of would-be proliferators — is one of Sandia's most enduring missions.** Reducing the threat posed by WMD remains a primary mission of the Laboratory today due to the ongoing threat of vertical proliferation within China and Russia, nuclear proliferation by North Korea and Iran, and the prospect of nuclear, chemical, or biological weapons falling into the hands of terrorists.

**Sandia conducts major efforts aimed at preventing the global spread of nuclear weapons and other WMD**. Technologies range from microscopic sensors to large information-gathering systems that help monitor compliance with international treaties and to prevent or detect the theft or diversion of nuclear, chemical, and biological weapons materials. Global Security pursues a cooperative approach to assisting international partners in deterring the acquisition and use of WMD.

**Sandia works to deter use of WMD through a counter and contain approach.** Global Security provides technology development, crisis response, consequence management, and partner training to protect assets and respond to WMD events.

**Traditionally, nonproliferation treaties and monitoring efforts have focused on detection of nuclear programs**. Over the past 70 years, the number of nations and individuals with knowledge of nuclear weapons and related technologies has consistently grown. Along with higher quantities of nuclear material being generated for weapons and peaceful nuclear applications, this proliferation of knowledge increases the risk that a non-state actor could procure a weapon or develop a crude nuclear device.

**The path to proliferation today is vastly different than it was 50 years ago**. New commercially available technologies, such as 3-D printing or genome editing, are potentially changing the technology landscape for obtaining nuclear, chemical, and biological weapon capabilities. Future nonproliferation efforts must continue work internationally to increase stability and transparency, improve detection capabilities, and reduce access of sensitive materials and technologies.



Global Security's leadership has identified three objectives within the preventing proliferation enduring mission. The following examples illustrate potential areas for future research and development:

1. Develop approaches for earlier detection of WMD proliferation through standard and novel pathways.
   - Establish and enhance expertise and capability for detection and analysis of WMD signatures and observables inside and outside the contiguous US.
2. Leverage emerging technologies to more effectively deter WMD.
   - Develop the next generation of technology and approaches to verify, without releasing sensitive information, treaty accountable items and critical assets.
   - Advance the research base for the next generation of safeguards, cooperative WMD safety and security tools.
3. Develop differentiating technologies to deter the use of WMD.
   - Define and broaden Sandia's role in timely disablement, response, and attribution for WMDs.

## MISSION OBJECTIVES

- Develop approaches for earlier detection of WMD proliferation through standard and novel pathways
- Leverage emerging technologies to more effectively deter acquisition of WMD
- Develop differentiating technologies to deter the use of WMD

## MISSION OBJECTIVE HIGHLIGHT

*Sanctions compliance and enforcement focuses on preventing proliferation by enhancing international compliance in partner countries. Through awareness raising, gap analysis, regulatory enhancements, and enforcement exercises, Sandia helps to reduce the trade and transportation of illicit goods and services to the North Korea and Iran nuclear and ballistic missile programs.*

# ENDURING MISSION
## Nuclear Weapon Security

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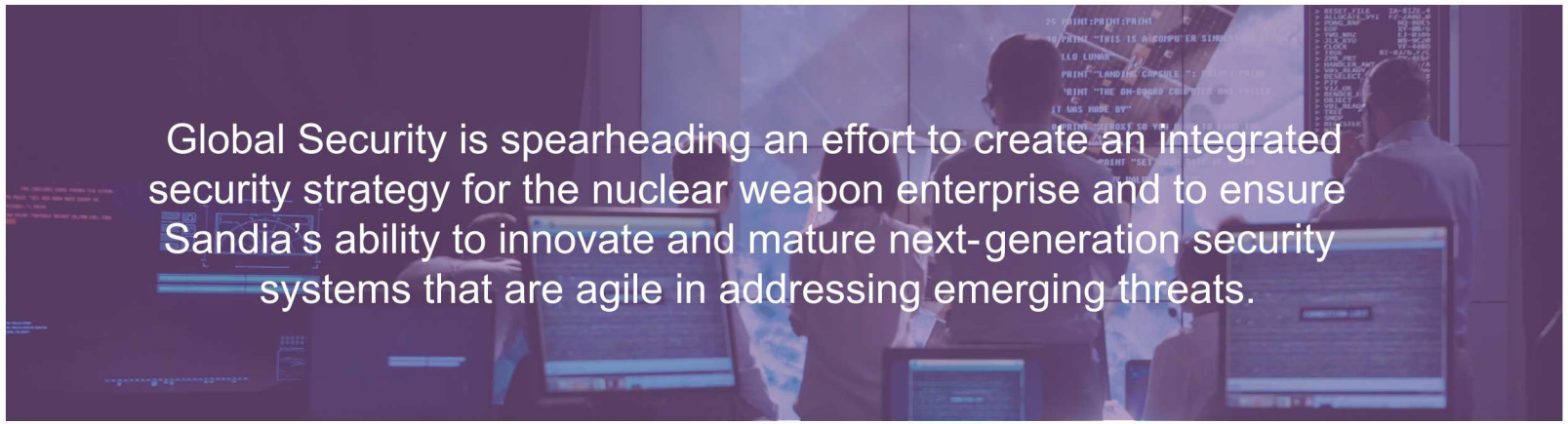
*Next-generation security architectures that are effective for emerging threats and alternative deployments.*

**Sandia's role as a steward of the US stockpile evolved to encompass physical safeguards and security of nuclear weapons, including during transport, around 1970.** Sandia designed the initial Safe Secure Trailer for transporting nuclear weapons and is now leading the development of the third-generation secure transportation system, Mobile Guardian Transporter (MGT). Recognizing the reality of more contested environments, MGT is designed to be a rolling secure vault, featuring a resilient structural design with a full suite of security systems.

**Global Security's Physical Security Center of Excellence supports the Department of Energy and Department of Defense in ensuring the security of the nation's nuclear arsenal and special nuclear materials**. Center personnel design and implement advanced systems for intrusion detection and denial and lead the development of integrated weapon and physical security systems of the future.





**Security systems for nuclear weapons have changed little over the last 30 years**. The current infrastructure relies heavily on a reactive monitoring approach with limited assessment outside of a perimeter and intrusion detection occurring only after the fixed -site perimeter is breached. Additionally, system components are treated as distinctive elements rather than viewed from a lifecycle perspective. Not only is this traditional approach prohibitively expensive, it relies exclusively on human beings for assessment, access control, guarding and response. Today's systems are rich in information but fail to utilize the rich set of data to improve sensing and assessment.

**Future systems will need to integrate autonomous technologies in detection and response, be more resilient to cyber-based attacks and allow for multiple layers of security with advanced external detection**. Additionally, future systems will also need to minimize the reliance on human interaction with critical components, implement greater delay tactics throughout the entire system, and utilize a holistic approach to lifecycle security.

Global security's leadership has identified two objectives to guide future development within nuclear weapon security's mission space:

1. Create and lead the execution of an integrated security strategy for the nuclear weapons enterprise.
   - Develop a lifecycle approach to security of nuclear weapons
   - Build/maintain a cross-trained capability of security expertise to provide forecasting, analysis, and decision support for emerging technologies/challenges.
   - Develop a robust capability to address the cyber-physical vulnerabilities with integration of hardware security and cyber security.
2. Ensure Sandia National Laboratories' ability to innovate and mature next generation security systems that are agile in addressing emerging threats.
   - Develop comprehensive variable-fidelity end-to-end modeling and simulation.
   - Ensure a seamless integration of human and machine in the physical security systems of the future.
   - Develop a robust capability for red teaming current and proposed security systems.

## MISSION OBJECTIVES

- Create and lead the execution of an integrated security strategy for the nuclear weapons enterprise.
- Ensure Sandia National Laboratories' ability to innovate and mature next generation security systems that are agile in addressing emerging threats.

## MISSION OBJECTIVE HIGHLIGHT

*Unmanned Aerial Systems (UAS) pose a great threat and an exciting opportunity to the world of Physical Security. Global Security teams are actively working in research, development, testing & evaluation of UAS for various national security applications as well as robust Counter UAS (cUAS) capabilities to ensure the protection of our nation's high-consequence assets against this rapidly growing threat.*


# United States Government Sponsors & Key Partnerships

**Sandia operates for the public interest with objectivity and independence and serves as a trusted advisor to provide long-term support, solutions to existing problems and emerging threats, and quick-response capabilities to its sponsors**. As an FFRDC, Sandia's role is to innovate in mission space and discover new technologies that provide national value in areas that do not compete with industry.

**Partnerships are integral to Sandia's ability to fulfill its national security missions**. In addition to fostering collaborations across industry, academia, national labs, and government, partnerships enable technologies to be deployed for the US public good and contribute to the economic well-being of the nation. Additionally, they enable key resources to focus on pathfinder systems by transitional "partner-ready" technologies to industry. In an environment operating at or above capacity, it is critical that Global Security leverage internal and external partnerships in areas where capabilities are not best-in-class, divisionally housed, or incongruous to mission space.

**Global Security partners with a variety of academic institutions and national laboratories to advance our missions.** Several examples include:

- Los Alamos National Laboratory
- Pacific Northwest National Laboratory
- Lawrence Livermore National Laboratory
- University of New Mexico
- University of Michigan
- University of Illinois at Urbana-Champaign

**Global Security operates in a diverse environment with wide range of stakeholders and sponsors**. Global Security equips sponsors with the means to deliver on their national security missions consistent with our three enduring missions: global monitoring, preventing proliferation, and nuclear weapons security.

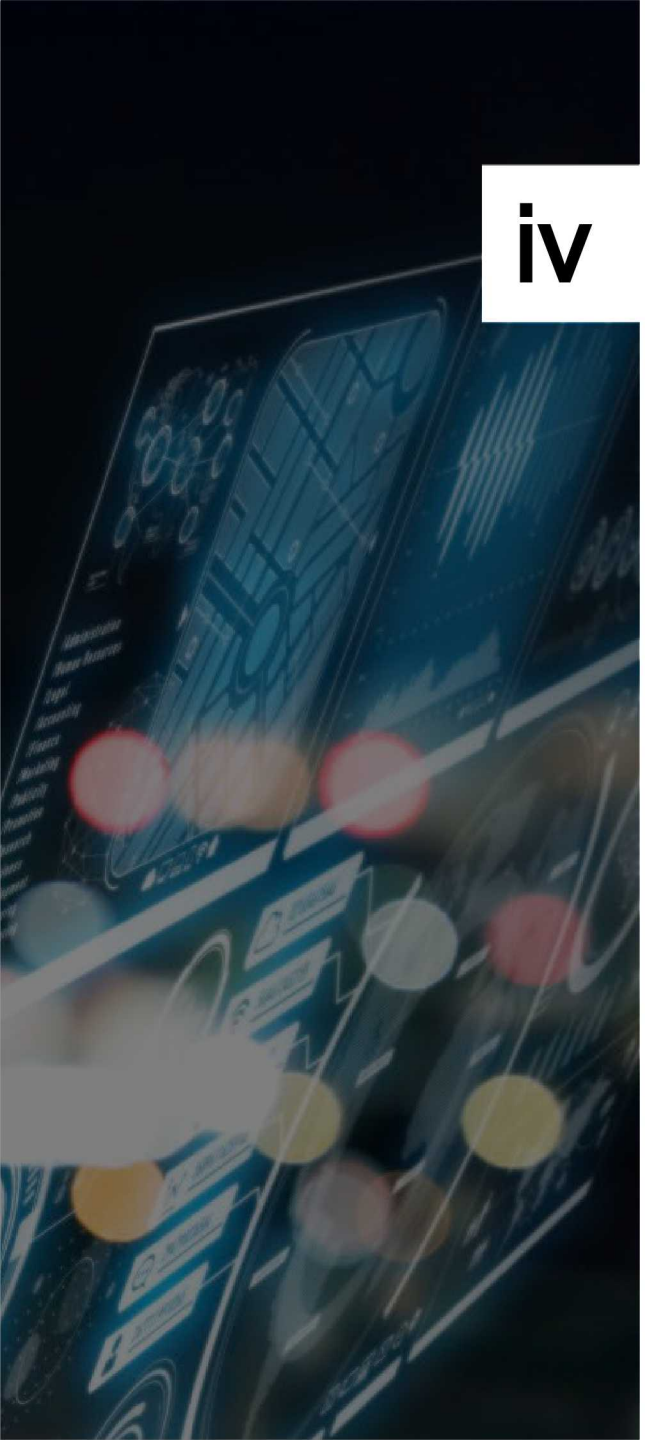
## USG SPONSORS

NNSA
National Nuclear Security Administration

**National Nuclear Security Administration**
Global Security's work supports NNSA's mission to maintain and enhance the safety, security, and effectiveness of the US nuclear weapons stockpile; reduce the global danger from WMD; and respond to nuclear and radiological emergencies in the United States and abroad.

- *Defense Nuclear Nonproliferation (NA-20)*
  Global Security supports NA-20's work in developing security and detection systems, verification systems for treaty compliance, disposal of nuclear materials, and advancement of monitoring and detection technologies.
- *Defense Nuclear Security (NA-70)*
  Global Security supports NA-70's mission through next-generation technology development, advances in security infrastructure, and revitalization across NNSA sites and facilities.
- *Counterterrorism and Counterproliferation (NA-80)*
  Global Security supports NA-80's work in nuclear forensics, nuclear incident response, and improved nuclear device safety and diagnostics.

**Other Strategic Partnership Projects**
Global Security leverages NNSA-relevant capabilities to also support the global monitoring and proliferation prevention efforts of the intelligence community, Department of Defense, and Department of State.



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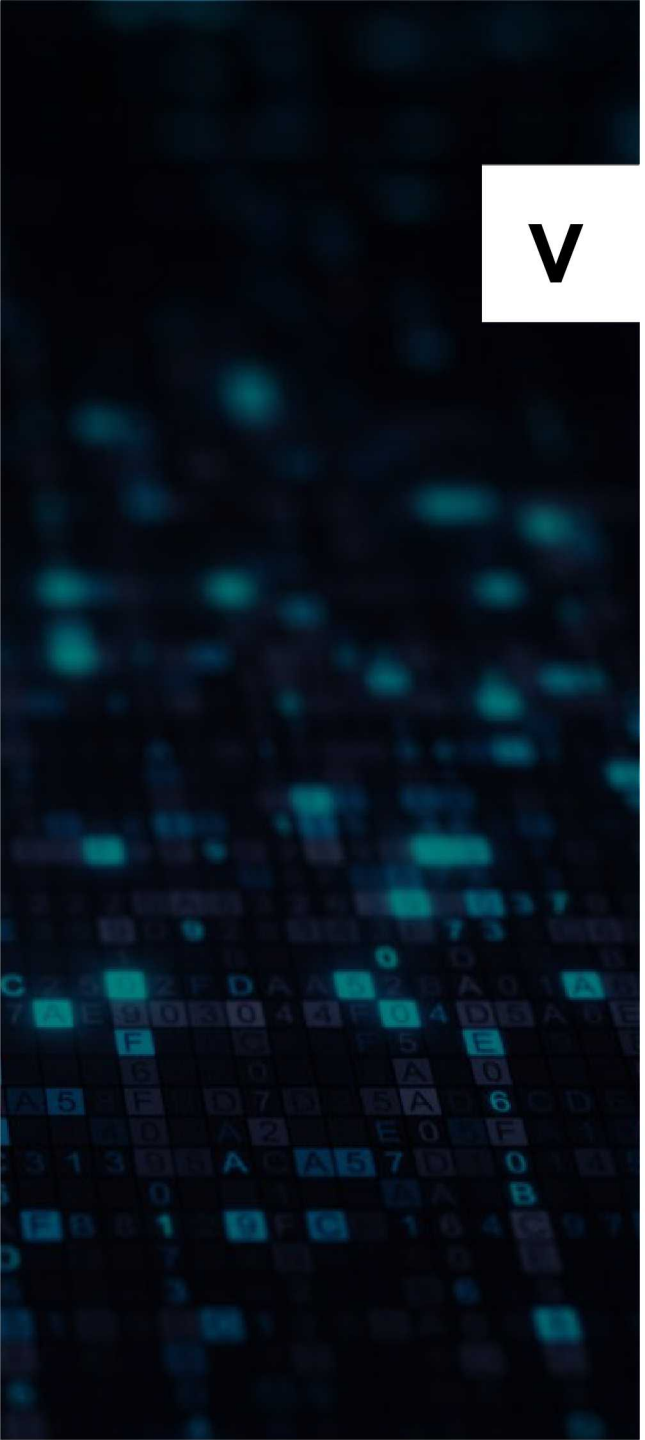
# Research and Development Areas

**Central to Sandia's role as a federally funded research and development center (FFRDC) is the Labs' capacity to deliver innovative engineering solutions to protect the nation from strategic threats at home and abroad**. Research and development (R&D) underpins Sandia's ability to provide novel ideas and unique solutions to our sponsors; advance the frontiers of science and technology in our mission space; and improve the ability to create an inclusive environment that attracts, retains, and engages talent.

**Global Security seeks to further advance Sandia's technical capabilities through investment in R&D in our enduring mission areas**. Looking at a 10-year horizon, the following research areas are of particular relevance for the Global Security mission:

- Data handling & logistics, data fusion and analysis, data-based model development
- Autonomy
- Novel sensing phenomenologies that enable earlier proliferation detection
- Understanding radiation effects on microsystems and microprocessors
- Novel optical sensing approaches
- Understanding and mitigating cyber-physical vulnerabilities
- Variable fidelity end-to-end modeling
- New material control and accountability approaches
- Assessing and disabling energetic systems
- Physics-based models to understand observables
- Human factors/ decision making



# Key Questions for Global Security Researchers

**Global Security seeks to fund a broad spectrum of R&D that maximizes national security mission impact and advances exceptional technological innovations and solutions**. All researchers pursuing funding from Global Security should consider the following key questions:

- How does your research align with the Labs-level and Global Security's priorities?
- What enduring missions will your work advance?
- How will your research advance the mission of NA-20 and other key sponsors?
- In an increasingly contested, rapidly evolving and data-rich world, how will the solutions you're developing address the needs of our key customers?
- What internal/external partnerships are critical to the success of your work? What opportunities are there for cross-divisional teaming?
- How is the problem solved today and what are the current limitations? Why will your idea succeed now?

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# Division 6000 Alignment with Global Security Missions

**The Global Security Portfolio encompasses efforts underway at Sandia National Laboratories to protect the nation from strategic threats at home and abroad.** Each center predominantly contributes to one or more of the three enduring missions as illustrated below:

## ENDURING MISSIONS


## CENTERS

- 6300 Systems Mission Engineering
- 6500 Weapons & Force Protection
- 6600 Asset Security & WMD Response
- 6700 Monitoring Systems
- 6800 Global Security & Cooperation