National Strategic Research Institute
University of Nebraska

Annual Report

September 2012 – September 2013

Who We Are

The National Strategic Research Institute (NSRI) at the University of Nebraska provides mission-essential research and development capabilities in five distinct core competencies:

- Nuclear detection and forensics
- Detection of chemical and biological weapons
- Passive defense against weapons of mass destruction
- Consequence management
- Space, cyber and telecommunications law

A NSRI partnership with USSTRATCOM and the Department of Defense aims to ensure the United States' safety and preparedness in response to threats to national security.

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I. Executive Summary

This is the first annual progress report for the National Strategic Research Institute (NSRI), a United States Strategic Command sponsored University Affiliated Research Center (UARC). The NSRI is affiliated with the University of Nebraska across four campuses: the University of Nebraska–Lincoln, the University of Nebraska Medical Center, the University of Nebraska at Omaha, and the University of Nebraska at Kearney.

The NSRI concentrates on five core research competencies in support of the United States Strategic Command and our nation's efforts to combat weapons of mass destruction:

- Nuclear detection and forensics
- Detection of chemical and biological weapons
- Passive defense against weapons of mass destruction
- Consequence management
- Space, cyber and telecommunications law

This 2013 NSRI Annual Report details the accomplishments of the faculty, staff, and researchers of the NSRI and University of Nebraska, as well as other partnering universities and industries, in advancing the science of countering weapons of mass destruction and the threats to our national security.

During the past year, NSRI was awarded 22 task order contracts to conduct research exceeding $9 million dollars - a significant accomplishment for our inaugural year and an immediate validation of the demand and value of the NSRI's research.

Our NSRI strategic vision is to:

- Conduct required research to address CWMD mission gaps
- Anticipate emerging/unexpected CWMD threats and through the UARC, rapidly respond with focused, collaborative concepts and capabilities
- Leverage UARC sole source contract to expedite required CWMD research
- Exploit University of Nebraska capabilities and it's ability to collaborate with other Universities to deliver effective research solutions
- Deliver potential "game changing" solutions to the toughest CWMD mission requirements
- Be "the lead research institution" for highest payoff CWMD capabilites and solutions

The establishment of the National Strategic Research Institute has created the required interface needed to successfully conduct the research and technology requirements of USSTRATCOM, Department of Defense, other federal agencies and the University of Nebraska. NSRI has completed its first year in operation on the journey to strengthening the partnership with USSTRATCOM and other Federal Agency sponsors and providing considerable prestige through the successful completion of tasks within our defined core competencies. Our core competencies serve as the perfect foundation to advance the research and technology capabilities of the University of Nebraska, while addressing significant national security requirements for combating weapons of mass destruction.

Robert C. Hinson, Lt Gen, USAF (Ret)
Executive Director, NSRI

II. Leadership

Executive Director Robert Hinson

Robert (Bob) Hinson serves as the founding executive director of the National Strategic Research Institute (NSRI) at the University of Nebraska. He joined the NSRI on August 1, 2012, after serving for nine years as vice president of government programs and corporate lead executive at Northrop Grumman Corp. Prior to joining Northrop Grumman, Hinson served 33 years in the U.S. Air Force, retiring at the rank of Lieutenant General in September 2003.

Board of Directors

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Vice-Chairman
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Vice President and General Counsel, University of Nebraska

Core Competency Research Coordinators

Detection of Chemical and Biological Weapons

Steven H. Hinrichs, M.D. is the Stokes-Shackleford Professor of pathology and microbiology and department chairman. He attained his specialty training in anatomic and clinical pathology at UC Davis and completed a medical staff fellowship at the National Institutes of Health. He was the founding director of the University-wide Center for Biosecurity and was responsible for developing a statewide laboratory system for detection and response to high risk organisms. He has directed projects with scientists from both the Centers for Disease Control and Department of Defense and was the laboratory section lead for the federal National Bio-surveillance Advisory subcommittee.

Passive Defense Against Weapons of Mass Destruction

Kenneth W. Bayles, Ph.D. received his doctorate in bacterial genetics at Kansas State University, and then performed post-doctoral studies at the University of Maryland. After nine years as a faculty member at the University of Idaho, he moved to the University of Nebraska Medical Center (UNMC) where he became the founding director of the Center for Staphylococcal Research (CSR) and combined the talents of several investigators to focus on the role of staphylococcal biofilm in the development of disease.

Nuclear Detection and Forensics

Kurt Preston, Ph.D. is the associate vice chancellor for research at the University of Nebraska–Lincoln. He leads faculty development efforts to improve research competitiveness; strategically plans for development of initiatives that draw upon the strengths of the faculty; collaborates with academic departments and colleges; and works to build collaboration between the University of Nebraska–Lincoln and the National Strategic Research Institute (NSRI).

Core Competency Research Coordinators & NSRI Staff

Consequence Management

Ann Fruhling, Ph.D. is associate professor and director of the School of Interdisciplinary Informatics at the University of Nebraska at Omaha. Dr. Fruhling has accrued over 25 years of academic and professional experience in research, teaching and managing IT projects. Since 2002, she has been the Principal Investigator of an emergency response system for public health laboratories called STATPack™ which is deployed in over 60 health laboratories across the Midwest.

Space, Cyber and Telecommunications Law

Matt Schaefer, J.D. is the chaired Law Alumni Professor of Law at the University of Nebraska College of Law and teaches in the areas of international law, foreign relations law, international business law, international trade law, cyber law and space law. He is director the space, cyber and telecom law program (since its inception in 2006) and developed the curriculum for the LL.M. program in 2007 and created the online LL.M. in 2012. He is co-chair, American Branch of International Law Association (ABILA) Space Law Committee, and member, International Law Association (ILA) Space Law Committee.

Director of Contracts

John Tencer serves as the director of contracts for the National Strategic Research Institute (NSRI). Prior to joining NSRI, he served in the U.S. Navy Supply Corps, retiring at the rank of Commander in October 2012. While serving, he was selected as a member of the Defense Acquisition Corps and earned Defense Acquisition Workforce Improvement Act Level III certification in contracting. He holds a MBA from Georgetown University.

Director of Finance

William M. Lawlor, certified public accountant (CPA), is NSRI's director of finance (DOF). Mr. Lawlor currently serves as director of financial compliance and cost analysis at UNMC. He has 25 years of experience in cost analysis, financial compliance, and budget management. He has an active CPA license and has extensive history in finance management and compliance for public, private, and nonprofit entities.

Facility Security Officer

Anna Ravnholdt has been the facility security officer (FSO) for the National Strategic Research Institute (NSRI) since its inception in October 2012. As the FSO, Ravnholdt has overall accountability for design, coordination, oversight, and implementation of NSRI's security programs. Ravnholdt is certified through the Defense Security Service in the FSO Program Management for Possessing Facilities.

Director of Research Compliance

Sara Conrad is NSRI's research compliance director and is responsible for ensuring NSRI's research regulatory compliance. Currently, she is the director of research compliance services in the Office of Research and Economic Development at the University of Nebraska–Lincoln. Conrad is well versed in interpreting compliance regulations as well as serving as a liaison between faculty and government agencies.

Business Development

Mark Warburton has worked a broad range of strategic issues for DoD, including nuclear weapons effects experiments, mobile ballistic missile operations concept design, ballistic missile defense penetration, and strategic relocatable target reconnaissance and attack. He currently directs the University of Nebraska's Great Plains National Security Education Consortium, one of the ODNI's Centers of Academic Excellence, which strive to identify, excite, and prepare the U.S. Intelligence Community's next generation of leadership.

Government Relations

Mark Bowen, who before UNMC served as chief of staff for the City of Lincoln, is the director of government relations at UNMC. Matching UNMC's needs to available funding sources, such as those associated with homeland security and defense, as well as identifying additional federal opportunities for non-peer reviewed research funding.

III.

The task order funding of NSRI in the first year has exceeded expectations. It is well known that the first few years of startup for a University Affiliated Research Center is a very complex and difficult process. NSRI recognizes that its ultimate success will result from becoming a trusted agent both to USSTRATCOM and the Department of Defense. All other NSRI goals, including financial ones, will stem from this primary goal.

NSRI's financial position for the first twelve months of operations ending September 30, 2013 reflected the following:

- Initial startup funding of $600,000 was provided from the University of Nebraska
- NSRI received contracts for 22 task orders and one Broad Area Announcement from Department of Homeland Security's Domestic Nuclear Detection Office, for a total of $9 million
- $349,592 of cash and net assets as of September 30th, 2013
- Approximately 75% of direct costs on task orders to date are for salary and benefits
- On average NSRI receives payment from DoD agencies within 30 days of invoicing

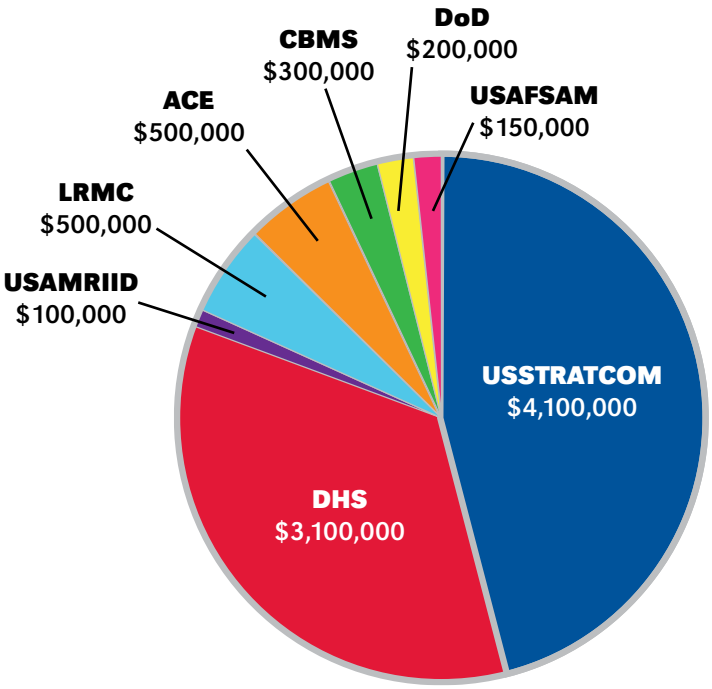
Note: NSRI is a 501(c)3 tax exempt corporation accounted for on a cash basis and the financial year end is June 30. However, for reporting purposes of this annual report and to match the year end of the sponsor, NSRI is reflecting information for the 12 month period from inception to September 30, 2013.

Financial

Award Distribution by Customer and Campus

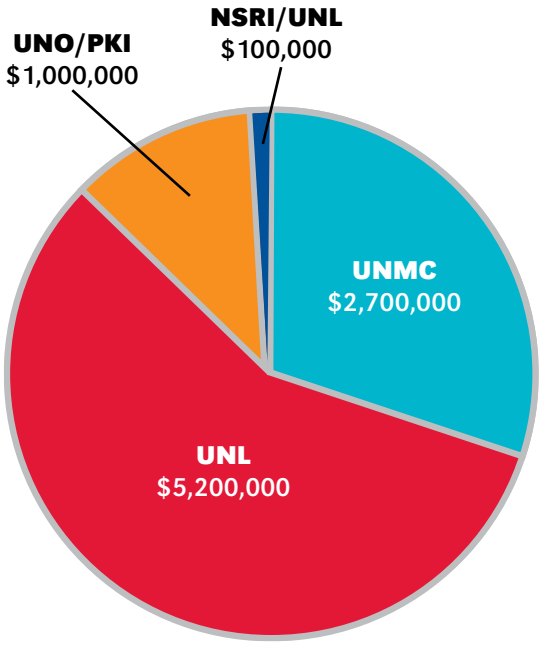
Award Funding by Customer

$9 million from Eight Customers



Award Funding by Campus

$9 million for Four Campuses



NSRI Financial Position

NSRI does not receive any direct program funding from USSTRATCOM, therefore NSRI relies completely on the successful award of task order contracts.

IV.


PETER KIEWIT INSTITUTE
INFORMATION SCIENCE, TECHNOLOGY & ENGINEERING

Awarded Research Projects

Nuclear Detection and Forensics

- Standoff detection of nuclear materials
- Post detonation nuclear forensics

Detection of Chemical and Biological Weapons

- Nanogel-based bio-agent sensing system
- Microbial field forensics
- Lyophilization of bioscavenger
- Bio-surveillance baseline assessment support
- Francisella tularensis differentiation assays
- Bio-agent sensing system alternatives

Medical Passive Defense against Weapons of Mass Destruction

- Research initiative for next generation anthrax vaccine
- Ricin vaccine prototype testing support
- Screening for BoNT/A inhibitors using the BoTest A/E BoNT detection assay
- Vaccine adjuvant formulations

Space, Cyber and Telecom Law

- None awarded

Consequence Management

- Behavioral and motivational factors that influence leaders' deterrence calculations
- Consequence management visualization and simulation toolkit for warfighting facilities
- Assessing USSTRATCOM critical needs
- Expansion of a multi-disciplinary, joint-service advanced telemedicine service for military medical care in deployed regions
- Creation of a pilot tele-preoperative medicine clinic at Landstuhl Regional Medical Center
- Decision support capabilities for national leadership
- Traffic calming elements for entry control facility threat delay and containment
- Command and Control Facility (C2F) capabilities assessment
- Convergence of CyberSpace and CWMD Pathways Phase I
- Convergence of CyberSpace and CWMD Pathways Phase II
- "Setting the Stage" - Strategies for priming an adversary during a CWMD deterrence strategy
- STRAT Graduate Fellowship Program

V. NSRI Management Plan

The National Strategic Research Institute (NSRI) at the University of Nebraska (NU) is a 501(c)3 subsidiary organization of the University Technology Development Corporation (UTDC), and the established University Affiliated Research Center sponsored by USSTRATCOM in the following areas of core competencies:

1. Nuclear detection and forensics
2. Detection of chemical and biological weapons
3. Medical passive defense against weapons of mass destruction
4. Consequence management
5. Space, cyber and telecom law

NSRI ensures research excellence, management oversight, and adherence to security and organizational conflict of interest requirements, enabling long term NSRI success. In addition, NSRI's central theme of partnership, the key themes of our management plan include:

- **Technical Competence:** This includes fundamental and applied research objectives and capabilities. We develop in collaboration with our sponsor, USSTRATCOM, a detailed research agenda that is coordinated with other Department of Defense (DoD) agencies. The NSRI is fully committed to collaborating as necessary to meet all research objectives.
- **Experienced Management:** NSRI's Executive Director (ED), Robert Hinson, who retired from the Air Force as a Lieutenant General, understands USSTRATCOM, its missions, and its technology requirements, having served as its Deputy Commander and as Northrop Grumman's Vice President and Deputy General Manager and Corporate Lead Executive for Nebraska. Mr. Hinson works with five Core Competency Research Coordinators (CCRCs), who hold senior positions at NU to execute Task Orders (TOs).
- **Responsive Management Plan:** NSRI designed a detailed management plan that is responsive to USSTRATCOM requirements while providing the flexibility necessary to adapt to unforeseen or evolving developments. Our plan relies on the functional expertise available within NU and leverages this expertise in support of NSRI objectives. Our intent is to provide USSTRATCOM with a single point-of-entry and interface to NU through the ED and NSRI.
- **Compliant Security Plan:** NU has worked closely with other UARCs to understand their security processes and have applied them, as appropriate, to NSRI. NSRI's ED and Facility Security Officer (FSO) are trained, experienced, and have Top Secret security clearances. They have developed and implemented a security plan compliant with all National Industrial Security Program Operating Manual (NISPOM) requirements and processes to clear staff and certify facilities.
- **Responsive International Traffic in Arms Regulations (ITAR) and Foreign National Access Management Plan:** Like most universities, NU has a significant population of foreign nationals. We have the necessary procedures, personnel, training, and infrastructure to ensure protection of controlled technology. Technology and foreign national management is coordinated by the NSRI Director of Research Compliance (DRC).
- **Growth and Excellence:** Finally, we understand that NSRI's success and growth depend entirely on performance excellence and customer satisfaction. All of our plans and proposed activities support this objective.

The NSRI Board of Directors is composed of seven board members. Three of the Board positions are held by NU's chief research officers – vice chancellor for research and economic development at the University of Nebraska–Lincoln (UNL), associate vice chancellor for research and creative activity at the University of Nebraska at Omaha (UNO), and, vice chancellor for research at University of Nebraska Medical Center (UNMC). This ensures the research programs at NU are integrated into the governance of NSRI.

Four additional board members have been appointed with military and/or industry expertise. The NSRI Board of Directors serve in an oversight role and have authority and responsibility to commit personnel, facilities, and other required resources to support the assigned tasks from USSTRATCOM and other DoD agencies as required.

The executive director and staff of NSRI are the focal point for USSTRATCOM's interaction with the UARC, streamlining DoD connection with the chief research officers and CCRC's associated with NSRI's core competencies. USSTRATCOM manages ordering procedures for use of its contract. NSRI works closely with USSTRATCOM, other DoD sponsors, and the 55th Wing Contracting Office to process and respond to all Task Orders. NSRI relies on an open and effective line of communication with government points of contact to appropriately define the required statement of work (SOW).

NSRI holds a top secret facility clearance which accommodates joint assignment agreements with faculty and investigators at NSRI and NU in order to conduct classified research under a Task Plan. Where classified information/data is involved, NSRI complies with the National Industrial Security Program Operating Manual (NISPOM) and the DD Form 254 (Contract Security Classification Specifications) included with each Task Order.

Quality Control:

To ensure maximum efficiency in the operations, NSRI monitors technical, cost and schedule performance on a monthly basis. This provides immediate visibility into project status and the timely implementation of a sponsor approved mitigation plan if and when problems arise.

Conflict of Interest:

Both NU and NSRI have established a DoD compliance and comprehensive conflict of interest policy.

Key Personnel and Security:

The key NSRI management personnel include the chairman of the board of NSRI, the executive director, the facility security officer, the CCRC's, and any researchers required to perform work specified by each TO DD Form 254. NSRI procedures have been established to identify all personnel assigned to work on any given Task Order and complies with the requirement to hire only U.S. citizens for projects requiring any level of security clearance. Also, NSRI does not assign a foreign national to any task order unless approval has been formally granted and approved by the sponsor.

VI. Featured Researchers

Medical Passive Defense against Weapons of Mass Destruction

Kenneth W. Bayles, Ph.D. received his doctorate in bacterial genetics at Kansas State University, and performed post-doctoral studies at the University of Maryland. His research is in the area of next generation anthrax vaccine.

James E. Talmadge, Ph.D. obtained his M.S. and doctorate degrees at Washington State University in bacteriology and veterinary pathology respectively. Initially, he worked at NCI-Frederick Cancer Research Facility and SmithKline Beecham before moving to UNMC.

Nuclear Detection and Forensics

Donald P. Umstadter, Ph.D. completed his doctorate in physics at UCLA, and a post-doctoral fellowship at AT&T Bell Laboratories. He is currently the Leland and Dorothy Olson Professor of Physics at the University of Nebraska–Lincoln. He founded and directs the Extreme Light Laboratory, where he is pioneering the science, technology, and applications of extreme light with the petawatt-peak-power Diocles laser.

Detection of Chemical and Biological Weapons

Steven H. Hinrichs, M.D. is the Stokes-Shackleford Professor of pathology and microbiology and department chairman. He was the founding director of the university-wide Center for Biosecurity and was responsible for developing a statewide laboratory system for detection and response to high risk organisms.

Detection of Chemical and Biological Weapons *(Continued)*

Marilynn A. Larson, M.Sc., Ph.D. is an assistant professor and principle investigator in the Department of Pathology and Microbiology at the National Strategic Research Center-University of Nebraska Medical Center (NSRI-UNMC). She is the principal investigator for the NSRI-UNMC Task Order 0028 that will develop F. tularensis differentiation assays for the DoD.

Serguei Vinogradov, Ph.D. graduated from Moscow State University in former USSR. He came to the University of Nebraska Medical Center in 1996 as a research faculty and is now a full professor. His experience is in the area of oligonucleotide chemistry, nucleotide diagnostics, and antisense technology and of research on the development of innovative drug molecules, drug delivery systems, and nanomedicine.

Jeyamkondon Subbiah, Ph.D. is a Kenneth E. Morrison Distinguished Professor of Food Engineering at the University of Nebraska–Lincoln. He has joint appointments in the Department of Biological Systems Engineering and Food Science and Technology.

Tony Sambol is an assistant professor at the University of Nebraska Medical Center. He serves as an assistant director of the Nebraska Public Health Laboratory (NPHL), and is the Manager of the NPHL's Special Pathogens & Biosecurity Laboratory sections.

Mario Scalora, Ph.D. currently serves as a professor of psychology at the University of Nebraska–Lincoln. He performs and supervises research regarding various aspects of targeted violence including threat assessment and management, counterterrorism, school violence, as well as workplace violence.

Douglas C. Derrick, Ph.D. is an assistant professor of IT Innovation at the University of Nebraska at Omaha and received his Ph.D. in management information systems from the University of Arizona.

Gina Ligon, Ph.D. is an assistant professor of management at the University of Nebraska at Omaha and serves as the director of research and development in the Center of Collaboration Science (CCS).

James Taylor, M.S.E.E., Lt Col (Ret.) USAF, is the research coordinator for the University of Nebraska's Peter Kiewit Institute (PKI), director of the PKI Advanced Computer Visualization and Modeling Laboratories, and lead for PKI's entrepreneurial activities.

Laurence R. Rilett, Ph.D. P.E. is a distinguished professor of civil engineering and the inaugural holder of the Keith W. Klaasmeyer Chair in engineering and technology at the University of Nebraska–Lincoln. He also serves as director of the UNL Nebraska Transportation Center.

VII.

Appendix

Index of Projects Awarded in FY13

Behavioral and Motivational Factors that Influence Leaders' Deterrence Calculations

Principal Investigator: Dr. Mario Scalora

Period of Performance: September 2012 -December 2013

Background: Decision making research exploring military issues have often assumed rational actor mindsets utilizing a cost-benefit analysis to describe the relevant cognitive processes. Within the evolving geopolitical environment involving a wider range of political and military leadership considering the use or proliferation of Chemical, Biological, Radiological, Nuclear (CBRN) weaponry, the intelligence community and USSTRATCOM must ask whether it is adequately incorporating behavioral and motivational factors.

Objective and Scope: The objective of this task order is to evaluate behavioral and motivational factors in the context of CBRN deterrence planning for a non-state, rogue, and near-peer adversary. The ultimate deliverable is a set of considerations that a deterrence analyst or planner can use to better estimate leaders' reactions to U.S. actions in various deterrence scenarios. This research will be performed under core competency #4 of the USSTRATCOM sponsored UARC, Consequence Management.

Nanogel-based Bio-agent Sensing System

Principal Investigator: Dr. Serguei Vinogradov

Period of Performance: September 2012 - September 2014

Background: Weapons of Mass Destruction are the number one threat to the American people. The Department of Defense (DOD) is developing biological point and standoff detection in order to provide warning to troops that is as soon and as accurate as feasible. Point and standoff detectors have different abilities to determine whether a plume contains a Biological Warfare Agent (BWA). Standoff detectors deployed in conjunction with point detectors placed upwind from a site would provide two independent kinds of warning: one that a plume is approaching and two that a plume contains a BWA. If the false-alarm rate is not too high, and in conjunction with other intelligence or warnings, it would be valuable to detect an approaching plume of biological material and order troops to find protection.

Objective and Scope: The objective of this task order is to provide novel, confirmatory analysis which could be utilized within a Program of Record such as the Next Generation Diagnostics System (NGDS). The method is expected to be temperature/humidity independent and contribute to the advancement of the overall standoff detection of biological warfare agents goals of the DoD.

Supporting Study on Anthrax Vaccine

Principal Investigator: Dr. Ken Bayles

Period of Performance: September 2012 - March 2015

Background: The current anthrax vaccine (Biothrax) is produced by generating lysates of Bacillus anthracis cells and performing a crude purification of the protective antigen (PA) present. Although this has been the Principal vaccine utilized for years, it is far from ideal due to its inability to produce high titers of protective antibodies, the requirement for multiple boosters, and the high incidences of adverse reactions to the vaccine. Although much has been invested in the production and use of recombinant PA (rPA) to replace the Biothrax vaccine, animal studies indicate that rPA is not as protective as Biothrax, strongly suggesting that other components within the Biothrax formulation act synergistically to enhance immunoprotection against anthrax infection. Unfortunately, no studies to assess the essential contributing factors within the Biothrax vaccine have been undertaken, primarily due to the lack of facilities and skills to perform the aerosolization studies needed to model anthrax disease.

Objective and Scope: To enhance the efficacy of rPA and provide an advanced, next generation anthrax vaccine for the protection of persons against both weapon grade and occupational exposure to anthrax, NSRI is to make use of the unique combination of facilities, experience, and industrial partnerships. Ultimately, these studies will lay the groundwork for the development of a next-generation anthrax vaccine formulation that will have both improved efficacy and safety, as well as a reduced frequency of scheduled administration required to maintain efficacy.

Decision Support Capabilities for National Leadership

Principal Investigator: Dr. Doug Derrick

Period of Performance: September 2013 - September 2015

Background: The Global Decision Support (GDS) and KNIFE JCTD's were initiatives to enhance the situational awareness of senior decision makers by expanding their decision timeline during key events. Enhanced Situational Awareness would be enabled through visualization of exposed data critical to the decision making process both vertically and horizontally, from analysts to National level decision-makers. The ultimate goal was to re-engineer/augment existing capabilities by reducing data discovery time, thus increasing situational awareness and providing a proportional expansion of decision space during crises.

Objective and Scope: Current Cold War systems, to include conferencing and warning systems, do not utilize modern information processing and display capabilities for delivering decision-quality information to senior leaders. This capability would enable more rapid situational understanding and provide additional time for Course of Action development, risk assessment and decision making for mitigating the impact of potential hostile enemy actions and man-made and natural disasters. NSRI will conduct technical discussions and research activities as directed by USSTRATCOM to pursue an independent academic/professional-based assessment of data integration capabilities to support decision-making and assess risks during National leadership decision making.

Microbial Field Forensics

Principal Investigator: Dr. Jeyamkondan Subbiah
Period of Performance: May 2013 - April 2014

Background: Weapons of Mass Destruction are the number one threat to the American people. Developing and maintaining capabilities for combating weapons of mass destruction (CWMD) is a national priority requiring long-term commitment.

Foodborne illness outbreaks occur in the United States with an annual frequency of approximately 76 million events (individuals, reported/diagnosed illnesses), 300,000 hospitalizations and 5,000 deaths each year over the course of years that national reporting has occurred. Standard food safety and epidemiological technical and investigative methods are used to determine origin and locations, source, etiologic agent, effects and impacts in order to inform public health response, outbreak management, recovery, and subsequent mitigation and prevention.

Objective and Scope: The scope of the project is to provide an all-inclusive assessment that will serve as a baseline for roles and capabilities in responding to an outbreak of foodborne illness affecting Department of Defense (DoD) or Department of State (DoS) personnel at Outside the Continental U.S. (OCONUS) locations. The objective of this task is to provide data to develop a concept of operations (CONOPS) to rapid, timely characterization of foodborne outbreaks involving Department of Defense (DoD) components and other U.S. interests deployed OCONUS. U.S. facilities and associated personnel deployed overseas are potentially subject to natural, accidental and deliberate foodborne illness outbreaks and could be potentially at greater risk if foodstuffs and prepared meals are procured from local sources. Additionally, in the countries where DoD and Department of State (DoS) components are deployed, host country response and investigative capabilities may not be as well organized, resourced nor as effective as the United States.

Assessing USSTRATCOM Critical Needs

Principal Investigator: Mr. Marc Warburton
Period of Performance: September 2013 - January 2014

Background: The Department of Defense's Unified Command Plan identifies USSTRATCOM as the combatant command responsible for, among other things, operations in space and cyberspace, synchronizing plans for combating weapons of mass destruction (CWMD), and advocating for capabilities.

Objective and Scope: The objective of this task order is to evaluate and assess the Command's mission areas to determine current capability gaps regarding Combating Weapons of Mass Destruction and Space and Cyber Policies. Once these gaps are identified researchers will evaluate them against current and future NSRI capabilities. These capabilities will be presented to USSTRATCOM subject matter experts as the deliverable for this task order.

Selection and Production of Next Generation Ricin Vaccine

Principal Investigator: Mr. Scott Johnson

Period of Performance: May 2013 - July 2014

Background: In 2008, a lot of Ricin vaccine (RVEc) was prepared under Good Manufacturing Practices (GMP) for the United States Army Medical Research Institute of Infectious Diseases (USAMRIID) based on a process that was developed at the University of Nebraska–Lincoln Biological Process Development Facility (UNL BPDF). This vaccine, consisting of a portion of Subunit A, was expressed intracellular utilizing an Escherichia coli BLR(DE3) clone containing the pET24a-RVEc plasmid. Expressed protein was released by mechanical cell disruption, clarified from cell lysate and purified via a three column chromatography purification process resulting in final material that met all technical specifications. Research, development, test and evaluation (RDT&E) to improve the quality attributes of a next-generation RVEc have included modification of amino acid residue(s) at positions 74-76; residues allegedly associated with vascular leak syndrome. To accomplish this, eight mutants have been generated, consisting of various modifications to amino acids 74 thru 76, for evaluation and possible replacement of the existing RVEc vaccine molecule.

Objective and Scope: The goal of this work is to evaluate new RVEc vaccine candidates and potentially produce a new generation RVEc vaccine. UNL BPDF will generate fermentation cell mass from eight existing mutant clones expressing modified forms of the current RVEc vaccine, as well as cell mass for the RVEc itself. This material will be analyzed by USAMRIID for clone selection. Once one or two clones have been down selected as potential candidates, UNL BPDF will perform process evaluation studies (upstream and downstream) on each down selected clone to ensure the existing process is capable of producing material which meets technical specifications for RVEc.

Vaccine Adjuvant Formulations

Principal Investigator: Dr. James Talmadge

Period of Performance: August 2013 - March 2014

Background: The Chemical Biological Medical Systems Joint Vaccine Acquisition Program (CBMS-JVAP) is the Department of Defense (DoD) organization responsible for developing, producing, and stockpiling Food and Drug Administration (FDA)-licensed vaccine systems to protect the warfighter from biological agents. The potential for the development of weaponized filoviruses makes the development of medical countermeasures (MCMs) against this viral pathogen a DoD priority.

The phylogeny of family Filoviridae is divided into two main branches, the Ebola viruses and the Marburg viruses. There are five known species of the Ebola virus, Zaire, Sudan, Reston, Taï Forest, and Bundibugyo, that are infectious in humans, and, to date, only one species of Marburg virus has emerged as infectious in humans. As such, the catastrophic potential of these lethal filoviruses elevates the priority to develop MCMs to prevent morbidity and mortality due to Ebola virus strains Zaire and Sudan, and Marburg virus. Currently, no licensed, safe, and effective vaccine is available to prevent acute hemorrhagic fever disease caused by filoviruses.

Objective and Scope: To design, execute, and report developmental and analysis studies to optimize alum-adsorbed filovirus VLPs. CBMS-JVAP aims to identify an alum-adsorbed filovirus VLP formulation strategy to optimize adsorption and stability.

Consequence Management Visualization and Simulation Toolkit for Warfighting Facilities

Principal Investigator: Mr. James Taylor

Period of Performance: April 2013 - August 2013

Background: The threat exists for a deliberate or inadvertent release of chemical, biological, radiological, nuclear or high-yield explosive (CBRNE) device on the U.S. or its allies. In such an attack, there is potential to cause significant numbers of casualties and high levels of destruction. During consequence management operations following an event, military forces must restore critical services to bases and installations and support state or local government to restore critical services to the population. Key to mitigating the effects of CBRNE events is the disaster preparation done prior to the consequence management phase of an incident. This preparation often involves training events and exercises to familiarize participants with procedures to undertake when a CBRNE incident occurs, however, the fidelity of these events is limited due to facility restrictions, limited training budgets, or impracticality of exercising certain scenarios. Research is needed into the use of visualization and simulation technologies to allow an affordable system model of critical infrastructure vulnerabilities, modeling of human behavior patterns in an operational environment, and the development of consequence management policies and procedures.

Objective and Scope: The objective of this task order is to develop a visualization and simulation model of interior rooms in a warfighting facility so that assessment and analysis of consequence management plans can be explored in a virtual environment. This technology would help decision makers assess operational effectiveness of the facility, analyze risk and exposure, and visualize impacts of various room configurations so their decisions would maximize safety of facility personnel, minimize configuration change time, and minimize the time required to restore operational capability following a CBRNE incident.

Post-Nuclear Detonation Debris Forensics

Principal Investigator: Dr. Donald Umstadter

Period of Performance: September 2013 - March 2015

Background: Weapons of Mass Destruction are the number one threat to the American people. Developing and maintaining capabilities for combating weapons of mass destruction (CWMD) is a National priority requiring long-term commitment.

Nuclear forensics can greatly benefit from the development of new methods for efficient identification of trace amounts of material, with a device that is capable of remote operation and field-deployment, as well as one that poses reduced radiological hazard to operators. Narrow-band and tunable high-energy x-rays have the unique potential to efficiently and selectively activate specific nuclei of interest, via excitation of the giant dipole resonance, and can do so without activating the accompanying refractory materials. Until recently, however, the only facilities capable of generating such x-rays were the size of a football field and consequently could only be operated at a fixed location. Now, with the development of compact laser-driven high-energy synchrotrons, x-rays with these characteristics could become available on a mobile, field-deployable platform.

Objective and Scope: The scope of the project is to provide a laboratory demonstration of a capability to use an x-ray source with photo-nuclear activation (PAA) for sensitive and efficient identification of actinides, with elemental and isotopic sensitivities that are relevant to nuclear forensics. Such a system may also be ideal for nuclear material forensics when a bomb is detonated to contaminate the environment with radioactive material, or for nuclear material identification in non-proliferation and verification. Preliminary PAA experiments are already underway with a University of Nebraska–Lincoln laser-driven x-ray source operating in broad-bandwidth, bremsstrahlung mode. This research will be performed under core competency #1 of the USSTRATCOM-sponsored UARC, Nuclear Detection and Forensics.

Traffic Calming Elements for Entry Control Facility Threat Delay and Containment

Principal Investigator: Dr. Laurence Rilett

Period of Performance: September 2013 - September 2014

Background: Since the unprovoked attack on the World Trade Center towers on September 11, 2001, the United States military installations at home and abroad have been required to implement additional security measures to protect military and civilian personnel from ever-present terrorist threats. To focus on threat containment, DoD started the process to upgrade all entryways using both passive and active barriers began in 2004. It has since become evident that many of the installed active vehicle barriers (AVB) within entry control facilities (ECF) fail to provide enough reaction time for force protection guards to contain a threat vehicle.

Objective and Scope: The scope of this task order is to perform and document physical tests and simulations on different types of traffic calming elements and determine their effectiveness in delaying and/or debilitating a threat vehicle within the ECF containment area. The objective is to provide force protection authorities operating the ECF the ability to immediately use the results of these tests to develop policies and preferred practices to increase the amount of reaction time available to ensure the threat vehicle does not penetrate the installation perimeter.

The Military Surface Deployment and Distribution Command, Transportation Engineering Agency through contract with Pennsylvania State University and Gannett-Fleming, Inc. conducted vehicle simulation and modeling. Results of this simulation will be incorporated into the defined tasks. Phase 1 of this work will require NU/NSRI to conduct physical testing to validate/invalidate the vehicle dynamic modeling already performed, and/or make recommendations to improve the capability of future modeling simulations.

BioSurveillance Baseline Assessment Support

Principal Investigator: Dr. Anthony Sambol

Period of Performance: September 2013 - April 2014

Background: Weapons of Mass Destruction are the number one threat to the American people. Developing and maintaining capabilities for combating weapons of mass destruction (CWMD) is a National priority requiring long-term commitment.

The National Strategy for Biosurveillance (NSB) defines biosurveillance (BSV) as "The process of gathering, integrating, interpreting, and communicating essential information related to all hazards threats of disease activity affecting human, animal or plant health to achieve early detection and warning, contribute to overall situational awareness of the health aspects of an incident, and to enable better decision making at all levels." Department of Defense (DoD) seeks a robust biosurveillance capability to address all hazards threats encountered as weapons of mass destruction (WMD), naturally-occurring biological events and emerging infectious diseases (EID).

USSTRATCOM has been identified as the co-lead to develop a baseline operational assessment of DoD BSV. The apex of the assessment will be a validation of the assessment studies via a tabletop exercise. The assessment will identify and map BSV stakeholder lines of communication and document interaction among the stakeholders. The assessment recommendations will improve communication, point out the gaps in communication, and provide visualization of the communication via Operational View product. The assessment is to develop comprehensive understanding of BSV at the operational and strategic levels. As DoD's Global Synchronizers of Combating Weapons of Mass Destruction, USSTRATCOM will co-lead with a geographic combatant command, U.S. Pacific Command (USPACOM) who will represent the DoD BSV Subject Matter Experts (SMEs) in main assessment and planning efforts.

Objective and Scope: The objective of the project is a fundamental assessment of non-federal BSV stakeholders' lines of communication, policies, roles, processes and capabilities, as it pertains to DoD entities. The objection of the research is to provide an assessment of preventing, preparing for and responding to a biological incident, naturally occurring or intentional, of concern to the Department of Defense (DoD).

What is unknown are the lines of communication to/from DoD to non-federal entities; both the pulling and sharing of information, in order to achieve early warning of health threats, early detection of health events, and overall situational awareness of disease activity. The objective of the tasks is to provide a strategic level assessment on the roles, processes, information, and lines of communication between and among non-federal stakeholders and the DoD. This assessment will be used to plug in to an overall whole-of-government/global assessment of DoD's BSV lines of communication.

USAF School of Aerospace Medicine Force Health Protection Technology and Global Health Surveillance Project Support (USAFSAM/FHT)

Principal Investigator: Dr. Marilynn Larson

Period of Performance: September 2013 - September 2014

Background: Tularemia is a zoonotic disease caused by the facultative intracellular pathogen ***Francisella tularensis***, and can be easily disseminated with a lethal dose of as few as 10 organisms, thus making it a potential bioweapon able to cause major health impact. Consequently the CDC has classified this pathogen as a Category A select agent. ***F. tularensis*** is comprised of four subspecies: ***tularensi***s (type A), ***holarctica*** (type B), ***mediaasiatica***, and ***novicida***. These four subspecies differ considerably in virulence, with the type A clade possessing greatest virulence and the latter subspecies possessing the least. ***F. tularensis*** is distributed globally with some geographic associations and can infect up to 250 different animal species, more than any other known zoonotic pathogen.

F. tularensis transmission occurs through oral, cutaneous, and conjunctival routes of exposure. Natural exposures to infected arthropods, animals, water, or food, are common modes of infection. The most severe form of this disease is pneumonic tularemia likely resulting from inhalation of contaminated aerosols (natural or man-made). Estimates of fatality rates as high as 35% for subsp. ***tularensis*** and 5-15% for subsp. ***holarctica*** have been reported (CIDRAP), necessitating consideration of respiratory route protection. From a Public Health (PH) and DoD Force Health Protection (FHP) perspective, it is necessary to know if a potential exposure from subsp. ***tularensis*** or ***holarctica*** has occurred.

All forms of tularemia if untreated can lead to hematogenous spread and eventual acute renal failure. While appropriate medical management is key for all exposures, rapid subspecies identification is imperative to ensure that respiratory protection is considered when appropriate; however, this capability is currently lacking.

Objective and Scope: The specific aims of this project will provide ***F. tularensis*** species-and subspecies-level differentiation assays for: 1) the currently fielded DoD Joint Biological Agent Identification and Diagnostic System (JBAIDS); 2) a multiplex-capable platform with benefits of minimizing technician time, decreasing number of assay runs and overall turnaround time. The ABI 7500 Fast instrument will serve as the developmental platform, but assays developed can be adapted to smaller-footprint platforms capable of forward deployment; and 3) high-resolution sequence-based genotyping platform.

Life Technologies' Ion Torrent will be used as the developmental platform for this aim, with assays developed capable of adaptation to smaller-footprint platforms for forward deployment. Each aim will independently be capable of identifying and subspeciating ***F. tularensis*** to guide appropriate PH/FHP/medical response, and the progression of the aims also forms a spectrum of increasing capabilities likely scalable and adaptable to meet "Next Generation" requirements.

"Setting the Stage"—Strategies for priming an adversary during a CWMD deterrence strategy

Principal Investigator: Dr. Mario Scalora

Period of Performance: September 2013 -September 2014

Background: Central to USSTRATCOM's mission of WMD Consequence Management is avoiding – or deterring – WMD use in the first place. Deterrence strategy is thus a key element of USSTRATCOM's CWMD portfolio. Deterrence strategies relevant to weapons of mass destruction involve a complex coordination of communication, military, and diplomatic strategies. Underpinning such strategies are facts and assumptions about the adversary, including if and how they receive deterrence messages, whether they understand them given their cultural and behavioral characteristics, and whether they believe the messages in the context of the scenario, actors, and relevant history. Taken together, these facts and assumptions represent the "environment" into which deterrence messages are injected, and from which the desired adversary action (or inaction) emanates. The effort described in this PWS will characterize this environment and identify proactive strategies that will modify this environment ***before a crisis*** – to "set the stage" if you will – to make adversaries more receptive to deterrence messages and more likely to positively respond to them when they are issued.

Objective and Scope: This effort will provide USSTRATCOM WMD deterrence planners with a comprehensive literature review proposed of the relevant behavioral and decision making literature relevant to the heuristics and related activity to assess proactive strategies for setting the stage or "priming" the adversary regarding the acceptance and response to strategic interactions.. These resulting factors will be at a general, or generic, level, broadly applicable to a range of adversaries and situations. The contractor will then work collaboratively with deterrence planners to apply these results in three real-world cases chosen by the government, probably to include peer, near-peer, and rogue adversaries.

Convergence of CyberSpace and CWMD Pathways (Phase 1)

Principal Investigator: Dr. Gina Ligon

Period of Performance: September 2013 - March 2014

Background: Countering Weapons of Mass Destruction (CWMD) is the number one threat to the American people, and cyber warfare is the escalating asymmetric threat plaguing National security and Homeland Defense. Developing and maintaining capabilities for (CWMD) is a national priority requiring long-term commitment. In a terrorism context, cyber attacks inside the United States could have "mass disruptive," if not "mass destructive" or "mass casualty" consequences. It is easy to envision a coordinated attack by terrorists, using a conventional or small-scale chemical device, with cyber attacks against law enforcement communications, emergency medical facilities, and other systems critical to a response. Moreover, it is conceivable that terrorists could mount a cyber attack against power or water facilities or industrial plants – for example, a commercial chemical plant that produces a highly toxic substance – to produce casualties in the hundreds or thousands. The most likely perpetrators of cyber attacks on critical infrastructures are terrorists and criminal groups rather than nation-states. That view has led to an assumption that detection of such attacks might fall to law enforcement agencies rather than to traditional national security authorities or, more probably, to the private sector. A crucial dimension is the extent to which the defense establishment is becoming more dependent on private infrastructures.

Objective and Scope: The scope of the project is to provide a study that will serve as a baseline understanding of an adversary's use of cyber assets to proliferate and employ WMD materials, technology, and expertise. WMD as a weapon may cause massive destruction or kill large numbers of people. Similarly, the use of cyber assets may cause disruption to critical infrastructure with economic and socio-political implications. The objective of this task is to provide an analytical study that addresses not only the nexus between non-state actors (i.e., Violent Extremist Organizations/VEOs) in the proliferation of WMD but also consequences and response capabilities of a simultaneous WMD cyberterrorism attack on national instruments of power.

Convergence of CyberSpace and CWMD Pathways (Phase II)

Principal Investigator: Dr. Gina Ligon

Period of Performance: September 2013 - September 2014

Background: Countering Weapons of Mass Destruction (CWMD) is the number one threat to the American people, and cyber warfare is the escalating asymmetric threat plaguing National security and Homeland Defense. Developing and maintaining capabilities for (CWMD) is a national priority requiring long-term commitment.

In a terrorism context, cyber attacks inside the United States could have "mass disruptive," if not "mass destructive" or "mass casualty" consequences. It is easy to envision a coordinated attack by terrorists, using a conventional or small-scale chemical device, with cyber attacks against law enforcement communications, emergency medical facilities, and other systems critical to a response. Moreover, it is conceivable that terrorists could mount a cyber attack against power or water facilities or industrial plants – for example, a commercial chemical plant that produces a highly toxic substance – to produce casualties in the hundreds or thousands. The most likely perpetrators of cyber-attacks on critical infrastructures are terrorists and criminal groups rather than nation-states. That view has led to an assumption that detection of such attacks might fall to law enforcement agencies rather than to traditional national security authorities or, more probably, to the private sector. A crucial dimension is the extent to which the defense establishment is becoming more dependent on private infrastructures.

Objective and Scope: This effort will be a continuation of Phase I. The scope of the project is to provide a study and experiment that will serve as a baseline understanding of an adversary's use of cyber assets to proliferate and employ WMD materials, technology, and expertise. WMD as a weapon may cause massive destruction or kill large numbers of people. Similarly, the use of cyber assets may cause disruption to critical infrastructure with economic and socio-political implications. The objective of this task is to provide an analytical study that addresses not only the nexus between non-state actors in the proliferation of WMD but also consequences and response capabilities of a simultaneous WMD cyberterrorism attack on national instruments of power. The research will be performed under core competency #4 of the USSTRATCOM-sponsored UARC, Consequence Management.

Bio-agent Sensing System Integration

Principal Investigator: Dr. Serguei Vinogradov

Period of Performance: September 2013 - September 2016

Background: Weapons of Mass Destruction are the number one threat to the American people. Developing and maintaining capabilities for combatting weapons of mass destruction is a national priority requiring long-term commitment. The Department of Defense (DoD) is continually improving biological point and standoff detection in order to provide warning to troops that is as soon and as accurate as feasible. Biological point and standoff detection can be used to warn of a possible tactical use of a Biological Warfare Agent (BWA) by either a State or non-state actor. Point and standoff detectors have different abilities to determine if there is a biological threat. For example, standoff detectors might be deployed in conjunction with point detectors placed upwind from a site that is to be protected that would provide two independent kinds of warning: one that a plume is approaching and two that a plume contains a BWA. If the false-alarm rate is not too high, and in conjunction with other intelligence or warnings, it would be valuable to detect an approaching plume of biological material and order troops to find protection. Biological detection can also be used to avoid or mitigate an epidemiological outbreak.

Objective and Scope: Under this task order, NU/NSRI, USSTRATCOM and its UARC partners will provide the nation with research efforts centered on Core Competency #2, Combating Weapons of Mass Destruction (CWMD), Detection of Chemical and Biological Weapons. The specific aim of this project is to explore the potential for synergy in commercial off the shelf (COTS) systems as well as mature systems and accessories not yet available commercially (i.e., still considered in research phase).

Command and Control Facility (C2F) Capabilities Assessment

Principal Investigator: Mr. James Taylor

Period of Performance: September 2013 - February 2014

Background: United States Strategic Command (USSTRATCOM) Command and Control (C2) Facility Program Management Office (PMO) is charged to lead and manage integration of the USSTRATCOM C2 Facility Military Construction (MILCON) with Command, Control, Computer, and Communications, Intelligence (C4I) Systems and Information Technology (IT) infrastructure, and ensure a smooth transition from the current USSTRATCOM LeMay complex to the USSTRATCOM C2 Facility (C2F) with minimal mission impact. The UARC will support the C2 Facility PMO team by adding capability as the PMO needs assesses and/or develops system capabilities for the USSTRATCOM C2 Enterprise, including the ability to monitor, assess, analyze, predict, plan, execute, and support global mission responsibilities. A modernized C2 enterprise within the C2F shall increase efficiencies and leverage capabilities for all mission areas, as well as reduce IT replacement and maintenance costs and provide expansion for potential future missions.

Objective and Scope: The purpose of this work is to enhance the effectiveness of the USSTRATCOM C2F, potentially resulting in faster and more effective senior leader communications and decisions. This research will be performed under Core Competency #4, Consequence Management, of the USSTRATCOM-sponsored UARC. This is the first of multiple phases in creating additional C2 Facility capabilities at USSTRATCOM.

Standoff Detection of Nuclear Materials

Principal Investigator: Dr. Donald Umstadter

Period of Performance: September 2012 - September 2013

Background: USSTRATCOM wants to explore innovative techniques and approaches for the detection of special nuclear material (SNM) at standoff ranges greater than or equal to 5km with high accuracy (i.e., a high probability of detection and a low probability of false alarm). The goal of SNM is to detect and locate containerized SNM (e.g., plutonium, 235U, and enriched isotopes of 235U or 233U) in outdoor environments at standoff distances of greater than or equal to 5km. Ultimately the detection approach should be amenable to support SNM sensor payloads on aircraft and satellites. Since alpha and beta particles are effectively shielded by containment, innovative concepts and approaches to detect secondary effects associated with neutron and gamma ray emission is of interest. Alternatively, Radiological/Nuclear (RN) sensitive material constructs (composed of naturally occurring or synthetic components) to enhance signal gain, and that may be interrogated remotely, are also worthy of consideration. The detector concept should be able to address mobile or static SNM sources. University of Nebraska has been developing one such innovative technique through its DIOCLES laser system.

Objective and Scope: The objective of this task order is to investigate various means to improve performance of the present laboratory based DIOCLES laser system as presently configured to produce energies capable of inducing reactions within the giant dipole resonance (e.g. 5 – 20 MeV) for a higher flux source. These efforts will help resolve specific critical challenges identified on individual task orders to help accomplish the mission. This research will be performed under core competency #1 of the USSTRATCOM sponsored UARC, Nuclear Detection and Forensics.

Other Contracts:
U.S. Department of Homeland Security

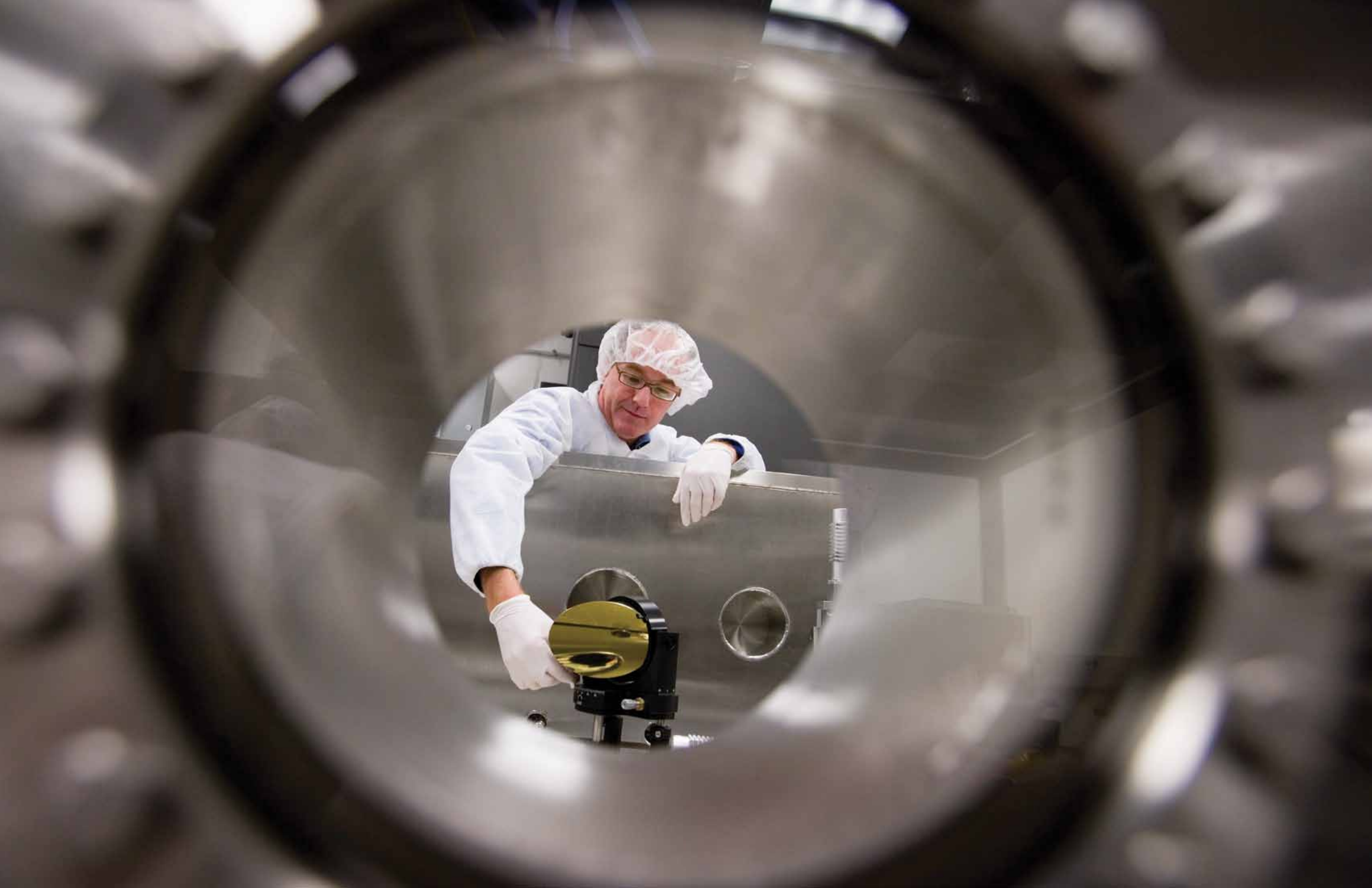
Principal Investigator: Dr. Donald Umstadter

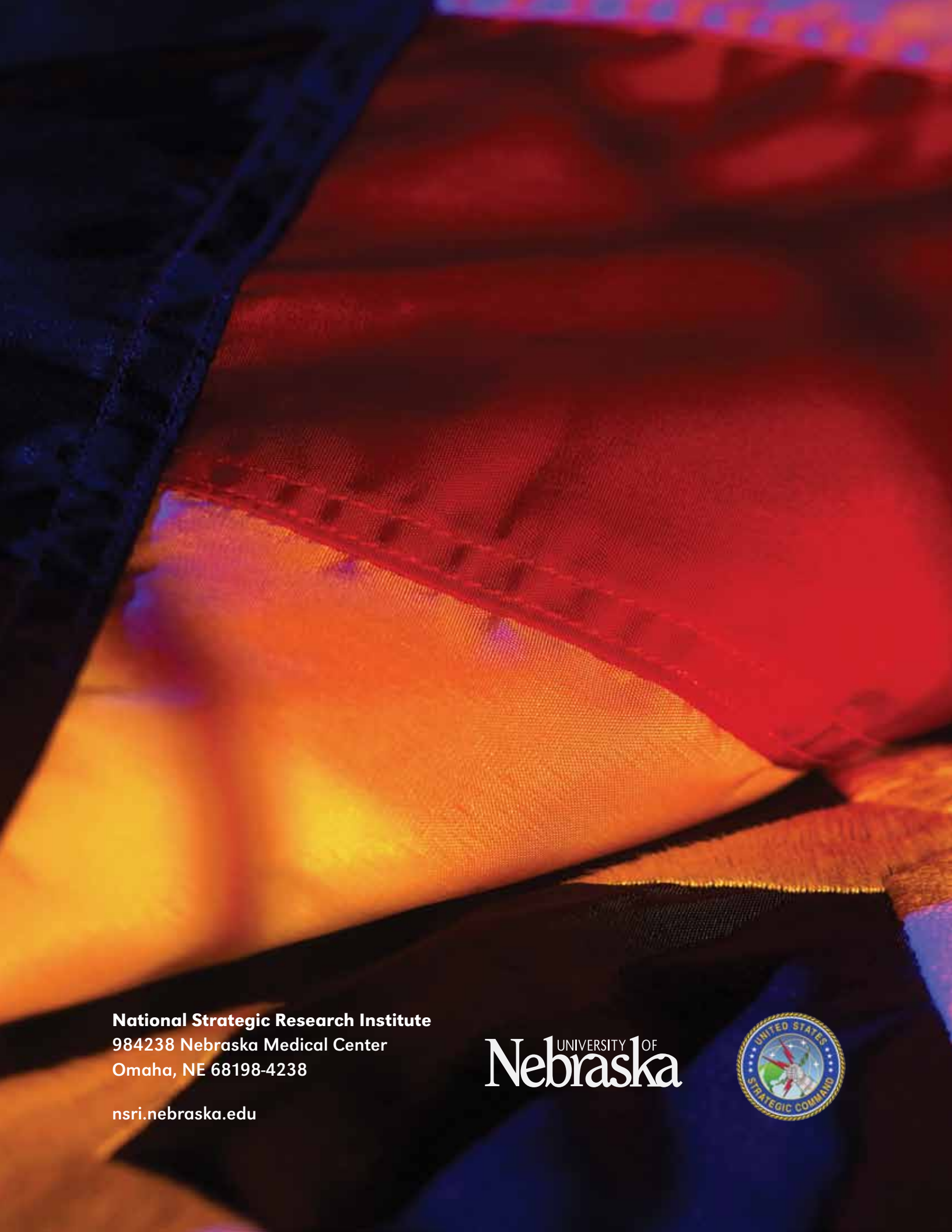
Period of Performance: September 2013 – September 2016 (with options)

Title: Low-Dose Radiographic System - Low-dose radiographic system based on a novel, narrowband, tunable, multi-MeV x-ray source

Background: A critical need exists for the design, develop, and demonstrate a novel radiographic system capable of rapidly and safely scanning the contents of shielded containers with the lowest possible dose.

Objective and Scope: The novel radiographic system shall be based on a compact all-laser-driven x-ray source. The design shall be limited to a breadboard laboratory environment and thus the components used shall be adequate for such an environment. The scope does not include the design or implementation of a mobile radiographic system. During this project the objective is to design, develop, and demonstrate a novel low-dose radiographic imaging system for rapidly scanning the contents of shielded containers. Extensive use of Monte-Carlo modeling shall optimize the system design process.





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