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Research and Development Directorate (RD)

Chief Scientist and Innovation Department (RD-ST)

Materials Science in Extreme Environments University Research Alliance (MSEE-URA)

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OVERVIEW INFORMATION

Agency Name:

Defense Threat Reduction Agency (DTRA)
Research and Development (RD) Directorate
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Funding Opportunity Title: DRAFT of the Materials Science in Extreme Environments University Research Alliance (MSEE-URA) Broad Agency Announcement (BAA)

Announcement Type: This is the draft announcement of this funding opportunity.

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Dates: This BAA is in effect from the final posting date through September 2019. Phase I pre-proposal submissions are due 60 days following the publishing date of the final BAA.

ADDITIONAL OVERVIEW INFORMATION

Purpose: DTRA is seeking to develop the capability to understand material properties and associated mechanisms in various extreme environments that may lead to future exploitation. The approach is to realize a materials and properties capability by establishing a new University Research Alliance (URA) focused on Materials Science in Extreme Environments (MSEE). The focus of the MSEE-URA will be to advance the fundamental understanding of various material properties and mechanisms in non-equilibrium high pressure, high temperature, and high photon number regimes.

The foundational problem to be addressed by the MSEE-URA is the lack of knowledge and predictive modeling capability for various material classes and their associated formation/decomposition mechanisms within harsh Weapons of Mass Destruction (WMD)-related environments. That lack of knowledge poses a challenge in the ability to control and exploit future material-WMD interactions. To address this problem, the MSEE-URA seeks proposals focusing on understanding, controlling, characterizing, and predicting interactions of materials in extreme pressure, temperature, and optical environments.

A wide range of WMD-relevant environments are of interest including: conventional fireballs, nuclear fireballs, photon-induced blow-off, plasmas, and warm dense matter. These environments are challenging not only due to the temperatures, pressures, and energies involved, but also the rapid evolution of the environments and the need to model across multiple time, energy, and physical time scales. Limited experimental testing opportunities and diagnostics adds to the challenge of understanding material responses in these extreme environments. A comprehensive integrated and collaborative approach is required to make progress on these challenges.

Fundamental studies of materials in harsh, WMD relevant environments including physical properties of several material classes, materials engineering, and high temperature (plasma) chemistry, are vital to understanding material-WMD interactions in relevant environments. A successful program will demonstrate a comprehensive capability to address materials and their

associated physical and engineering properties, as well as chemical mechanisms within relevant and harsh regimes. The four research areas for the MSEE-URA are as follows and include possible desired research outcomes (shown as sub-bullets, a. b, c) within those four research areas.

- Material Properties and Failure – (a) Produce materials constitutive models and failure models applicable at fast rates ($10^2 – 10^6$ s^{-1}) for hard rock and cementitious materials,; (b) Experimentally identify material properties contributing to sensitivity of energetics and composite materials (including reactives and additively manufactured materials); (c) Identify material property/numerical sources of uncertainty and sensitivities for nuclear models.

- Materials Development and Manufacturing for Synergistic Effects - (a) Develop structure-function-property relationships of additively manufactured reactive materials, additive manufacturing of multifunctional nanocomposites, ignition/combustion, dynamic imaging of post combustion fields; (b) Fabricate multifunctional shielding materials that incorporate electromagnetic pulse (EMP) shielding while maintaining other requirements such as weight, cost, ballistic protection, ionizing radiation protection; (c) Identify combinations of energetics/non-energetic materials that produce synergistic effects and/or identify material properties that may lend well to tailored performance.

- Chemistry in Extreme Environments - (a) Construct validation models that predict nuclear fireball behavior in complex urban environments and identify fundamental experimental measurements that could improve models. (b) Develop high temperature/high heating rate chemical mechanisms and associated Arrhenius kinetic models for low vapor pressure organophosphorous species.

- Photon-Material Interactions - (a) Improve understanding and predictive models of X-ray energy deposition, material blow-off, and plasma generation and evolution for ensuring the survivability of space solar arrays and strategic systems; (b) Improve models, materials, and approaches for utilizing direct laser impulse testing to simulate blow-off impulse of strategic systems; (c) Identify conditions for onset of optical ignition/pyrolysis of reactive materials, composites, and organophosphorous species and determine decomposition pathways (of same species) via optically controlled parameters (e.g. wavelength, pulse length, phase control, etc.).

The MSEE-URA is intended to create a collaborative environment that enables an Alliance to advance the state of the art and assist with the transition of research to enhance and predict with confidence the performance of materials of interest to DTRA. DTRA believes that the establishment of the MSEE-URA in conjunction with robust internal mission programs, provides the optimum path to success.

It is anticipated that the predominance of work conducted by the MSEE-URA will be fundamental research as defined in National Security Decision Directive (NSDD) 189, National Policy on the Transfer of Scientific, Technical, and Engineering Information. Initially the research conducted by the MSEE-URA will align under Budget Category 6.1 (Basic Research) funding. However, to provide the Government with the most flexibility, the cooperative agreement (CA) will also allow participation from other Government agencies and may result in

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additional Budget Category 6.1 funding as well as some Budget Category 6.2 funding (Applied Research funding; see discussion of Enhanced Program in Section 1.6). Thus, the research conducted for the MSEE-URA will fall within the first four Technology Readiness Levels (TRLs).

It is envisioned that the results (materials, models, etc.) of the MSEE-URA research will be efficiently and rapidly transitioned to applied DTRA research and development programs.

Award Instrument and Structure: This Broad Agency Announcement (BAA) is expected to result in the award of a CA as defined at 31 United States Code (U.S.C.) 6305 for the execution of the program. The CA will be awarded to an Alliance of United States (U.S.)-based organizations that may include U.S. institutions of higher education, Department of Defense (DoD)-Degree Granting Colleges and Universities, DoD Service Labs, U.S. industrial partners, and/or U.S. non-profit organizations. At this time, performance under the CA is not limited to individuals designated as U.S. Persons; however, individual participation could be limited in the future based on DoD policy changes.

The Alliance must be led by a U.S. institution of higher education charged with spearheading the focused basic research program. This organization will be designated as the Lead Research Organization (LRO). Each Research Area (RA) will be led by a different U.S.-based institution of higher education that will be designated as the Lead Research Area Organization (LRAO). One of the LRAOs could also be the LRO; however, the same entity cannot be the LRAO for more than one RA. Together the LRO and LRAOs make up the permanent Alliance members, who are responsible for shaping and steering the URA through collaboration with DTRA. Collectively the URA members and DTRA make-up the Consortium. Performance under the URA and resulting CA will likely also include organizations beyond the LRAOs as subawardees to the LRO. These subawardees are non-permanent members of the URA.

Alliances are encouraged to include Historically Black Colleges and Universities (as determined by the Secretary of Education to meet requirements of Title III of the Higher Education Act of 1965 as amended, 20 U.S.C. § 1061) and from Minority Institutions defined as institutions "whose enrollment of a single minority or a combination of minorities…exceeds 50 percent of the total enrollment," 20 U.S.C. § 1067k(3).

While DTRA anticipates that a single award may be made from this BAA, the Government reserves the right to fund all, some, or none of the proposals submitted; may elect to fund only part of any or all proposals; and may incrementally fund any or all awards under this BAA. The Government also reserves the right to request applicants make any changes necessary to documents submitted as part of an application package to increase the feasibility of making the proposal fundable. Applicants may decline to participate in any revisions to application packages requested by DTRA.

Proposal Submission: The BAA will be conducted in two phases. Phase I is for receipt and evaluation of pre-proposal submissions. Phase II is for receipt and evaluation of invited proposal packages. Invitation to submit a Phase II proposal will be based on the evaluation results of the Phase I pre-proposal submission.

All submissions must be made in accordance with the submission instructions in this BAA through www.grants.gov using the application packages linked with this BAA (under the "Package" tab) on www.grants.gov. Applicants are responsible for ensuring compliant and final

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submission of all applications. Any submission that does not conform to the requirements outlined in the BAA and in the invitation for Phase II submissions may not be reviewed or considered further at the discretion of DTRA.

Period of Performance: Efforts may be proposed for five years with two additional two year options. The total possible period of performance is nine years.

Funding: The CA may range from $5M to $7M annually (total, including both direct and indirect costs) depending on the nature and the scope of work. This BAA is issued subject to the availability of funds. The funding levels provided are to allow applicants to prepare estimates only. Payments on CAs will be made in advance, subject to the conditions described in 2 Code Federal Regulations (CFR) 200.305.

Profit/Fee: In accordance with 32 CFR §22.205, profit/fee is not permitted under the CA.

Cost Sharing: Cost sharing is not required under this BAA; however, efforts that include cost sharing or in kind contributions are allowed.

Terms and Conditions of Awards: Any CA awarded under this announcement will be governed by the award terms and conditions, which conform to DoD's implementation of The Office of Management and Budget (OMB) circulars applicable to financial assistance. This includes DoD implementation of OMB guidance in 2 CFR part 200, "Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards."

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1. PROGRAM DESCRIPTION

1.1. Introduction

The Defense Threat Reduction Agency (DTRA) safeguards America and its allies from weapons of mass destruction (WMD) and provides capabilities to reduce, eliminate, and counter the threat and effects from chemical, biological, radiological, nuclear, and high yield explosives. DTRA seeks to identify, adopt, and adapt emerging, existing and revolutionary sciences that may demonstrate high payoff potential to Counter-WMD (C-WMD) threats. As a combat support agency, DTRA provides both operational support and specialized capabilities in science and technology (S&T). The Agency is the premier Department of Defense (DoD) source of science-based WMD expertise and a sponsor of basic research focused exclusively on WMD threat reduction.

Regarding the current WMD threat environment, the 2018 Nuclear Posture Review (NPR) states, "Nevertheless, global threat conditions have worsened markedly since the most recent, 2010 NPR. There now exist an unprecedented range and mix of threats, including major conventional, chemical, biological, nuclear, space, and cyber threats, and violent non-state actors. International relations are volatile. Russia and China are contesting the international norms and order we have worked with our allies, partners, and members of the international community to build and sustain. Some regions are marked by persistent disorder that appears likely to continue and possibly intensify. These developments have produced increased uncertainty and risk, demanding a renewed seriousness of purpose in deterring threats and assuring allies and partners."

Overcoming the most difficult technical challenges for combatting WMD requires revolutionary advancements in S&T. Only strategic investment in basic research will lead to the scientific breakthroughs needed for future WMD threat reduction. The strategy for the basic research program is to target unique C-WMD challenges within DTRA's mission space. The program's goals are as follows:

- Train the next-generation workforce;
- Advance the fundamental knowledge and understanding in the sciences;
- Promote university research to support WMD threat reduction; and
- Facilitate transition of research that enables new capabilities for the warfighter.

The program avoids preconceptions about specific applications or solutions in order to preserve the integrity of basic research. However, to maintain the relevance of the program to the larger DTRA mission and to ensure focus on the strategic goal of transitioning the research to enable new capabilities for the warfighter, the applied research requirements across the Agency are used to inform our choices. This approach has successfully attracted outstanding research institutions and a new generation of scientists into the field of WMD threat reduction. It also provides a hedge against the uncertainty of future threats and technology surprise.

To continue and expand on the program's success to date, DTRA is evolving the investment strategy for basic research. DTRA intends to establish a new collaborative venture that seeks to investigate Materials Science in Extreme Environments (MSEE) in the context of future WMD-relevant operations through a new University Research Alliance (URA) that will consist of United States (U.S.) university researchers working to solve complex problems. The overall

objective is to develop the fundamental understanding of material properties and mechanisms in extreme pressure, temperature, and optical regimes. A better understanding of these materials and the related environments may enable future materials and modeling solutions.

DTRA strongly believes that a joint collaborative approach by multidisciplinary researchers is required to make fundamental advances towards meeting the MSEE-URA goal to develop a fundamental understanding of materials response in extreme conditions (e.g., pressure, temperature, etc.) and enhance our ability to predict or exploit their response. DTRA has identified four interrelated Research Areas (RAs) that when jointly studied will advance the theoretical foundations of MSEE-URA in the context of future operations.

- RA1—Material Properties and Failure,
- RA2—Materials and Manufacturing for Synergistic Effects,
- RA3—Chemistry in Extreme Environments, and
- RA4—Photon-Material Interactions.

In addition to these four RAs, the area of Modeling and Diagnostics has been identified as a Cross Cutting Research Initiative (CCRI) that is inherent in each of the RAs and that must be jointly studied with the RAs to make fundamental advances in MSEE-URA.

The MSEE-URA is intended to create a collaborative environment that enables the Alliance to advance the state-of-the-art and to take advantage of the diverse scientific capabilities and viewpoints of both the academic sector and government personnel. The MSEE-URA will work collaboratively with DTRA Technical Points of Contact (TPOCs) to develop research programs and identify areas where joint, multi-disciplinary, collaborative research is advantageous. Continuous collaboration through technical exchanges, site visits, student development, etc. and outreach opportunities will strengthen and improve the MSEE-URA research and its DoD relevance.

As part of the URA, DTRA Program Managers (PMs)/scientists/engineers may have substantial involvement in performance, including engaging in deep and meaningful collaborative research across the URA team. In order to be prepared to address future and uncertain WMD threats, the formation of this URA follows in accordance with the 2018 National Defense Strategy for cultivating a more talented civilian workforce which states, “A modern, agile, information-advantaged Department requires a motivated, diverse, and highly skilled civilian workforce. We will emphasize new skills and complement our current workforce with information experts, data scientists, computer programmers, and basic science researchers and engineers—to use information, not simply manage it.”

1.2. Programmatic Strategy

The Cooperative Agreement (CA) will be awarded to an Alliance of organizations that may include U.S. institutions of higher education, DoD-Degree Granting Colleges and Universities, DoD Service Labs, U.S. industrial partners, and U.S. non-profit organizations.

The Alliance will work in collaboration with DTRA TPOCs to advance the state-of-the-art in MSEE to meet the challenges of future military operations. DTRA and the URA selected for award will establish the Consortium that will work collaboratively to conduct basic research addressing key scientific gaps and barriers critical to MSEE. Additionally, other government

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agencies may participate in the MSEE-URA and contribute their technical expertise, personnel, and facilities. A significant goal of this effort will be to create a critical mass of collaborating scientists and engineers focused on the challenges outlined within the scope of the MSEE-URA. This intellectual synergy is also expected to include sharing equipment, personnel, and facilities to promote efficiency and enhance collaboration.

It is anticipated that the predominance of work conducted by the MSEE-URA will be fundamental research, in accordance with the Under Secretary of Defense for Acquisition, Technology and Logistics Memorandum, SUBJECT: Contracted Fundamental Research, dated 26 Jun 2008. Fundamental research is basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons. Contracted fundamental research includes research performed in the CA that is (a) funded by Budget Category 6.1 (Basic Research), whether performed by universities or industry or (b) funded by Budget Category 6.2 (Applied Research) performed on-campus at a university. Fundamental research provides for S&T research and early applied development. It seeks to lower performance risk to a manageable level and facilitate transition and funding to capability end-state programs.

Initially the research conducted by the MSEE-URA will align under Budget Category 6.1 (Basic Research) funding. However, to provide the Government with the most flexibility, the CA will also allow participation from other Government agencies and may result in additional Budget Category 6.1 funding as well as some Budget Category 6.2 funding (Applied Research funding; see discussion of Enhanced Program below). Thus, the research conducted under the MSEE-URA CA will fall within the first four Technology Readiness Levels (TRLs). TRLs provide a systematic metric/measurement system that supports assessments of the maturity of a particular technology and the consistent comparison of maturity between different types of technology.

Based upon the gaps discussed below, the research and collaboration strategy developed by the applicant should adopt a systematic approach to fundamental research focused on materials and associated extreme environments phenomena so that techniques can be used to uncover hidden insights within meaningful events regimes which may be further manipulated to design and control for desired effects. Applicants must carefully choose research topics to ensure a critical mass of researchers addressing the challenges proposed. Applicants are expected to roughly apply resources to each of the four RAs as shown below:

- RA1—Material Properties and Failure (~15%),
- RA2—Materials and Manufacturing for Synergistic Effects (~25%),
- RA3—Chemistry in Extreme Environments (~35%),
- RA4—Photon-Material Interactions (~15%).

Research in each RA must not be stove-piped and must inform and be informed by the developments in the other three RAs given the strong inter-dependencies between the four RAs. Further, a portion (~10%) of the research budget must address the CCRI of Modeling and Diagnostics. The CCRI resources are an integral part of the RA efforts.

This BAA aims to solicit the most creative, innovative, and flexible approaches to the ultimate

goal of generating and exploiting research to solve pressing research gaps and issues impacting both the military and commercial sectors. This BAA seeks Phase I pre-proposal submissions and invited Phase II submissions; this BAA may result in the award of a single CA. In response to the BAA, applicants will be required to:

- Define the strategy for implementing an approach which synergistically integrates the four RAs and the CCRI and outline the metrics by which success of the program is expected to be measured.
- Scope and define the research, appropriate to the overall funding of the URA, ensuring all elements of the proposed research are tightly integrated in a way that results of research in one area support and enhance the results in other areas. Applicants should identify the most critical research issues and describe how the set of research efforts meet the goals of this program. Sufficient resources should be allocated to ensure enough critical mass to make fundamental progress.
- Formulate a basic research program which clearly demonstrates innovative, detailed and substantive scientific plans to address each of the four RAs and the CCRI. The proposal should clearly articulate the applicant's vision for the area and the applicant's research goals for the program (the base period and for each additional option).
- Present the experience, qualifications and availability of the scientific staff and the quality and relevance of research facilities.
- Identify approaches to building collaborations within the Alliance and with DTRA, which are essential to the success of the MSEE-URA.
- Identify the overall management (business plan) and programmatic and administrative team with the expertise to achieve the stated research goals and to oversee and manage finances, reporting, data, meetings, reviews and intellectual property.

1.3. Research Strategy

DTRA seeks to develop an increased understanding of effects of WMD and C-WMD events on materials and the effects of those materials on the events. This includes both testing, characterization, and modeling of material as well as control and manipulation of materials to achieve the desired results. An enhanced understanding of fundamental properties may lead to significant advances for the warfighter. Fundamental studies of WMD related materials in harsh environments that include physical properties, materials synthesis/characterization/engineering, high temperature (plasma) chemistry, and high photon interactions with materials would be critical to understanding next generation weapons effects in future WMD relevant environments. To address these challenges, DTRA's approach is to establish a MSEE-URA to pursue research across four interrelated research areas (RAs) which bridge a number of mission sets. At a high level, MSEE seeks to better characterize the dynamic response of materials and their properties across various material classes (RA1). Similarly, MSEE needs to be able to explore new material combinations that can be engineered to provide a desired response, many times in harsh environments (RA2). Furthermore, some of these materials classes can be utilized to create harsh pressure, temperature environments containing WMD threat materials. Being able to understand the fundamental reaction routes and associated kinetics may lead to future material needs and better predictive capabilities of those material-threat interactions (RA3). Finally, a better understanding of fundamental material-photon interactions may lead to new capabilities in

those extreme photon environments and other high pressure, high temperature regimes (RA4). Finally, there is a need for advanced diagnostics for measuring material properties and conditions as well as cross-domain models for predicting material property and the immediate surrounding environment that will inform all the RAs (Cross Cutting Research Initiative).

Figure 1 illustrates the general structure of the URA, the underlying RAs, and what possible research Focus Areas (FAs) would support the individual RAs (RA1-RA4). Specific FAs within these RAs may evolve over the lifetime of the URA. FAs shown in green should be addressed within the IPP of the proposal. If the remaining topic areas shown in blue are not addressed in the Initial Program Plan (IPP), then they will be expected to be addressed in the follow-on Bi-annual Program Plan (BPP).

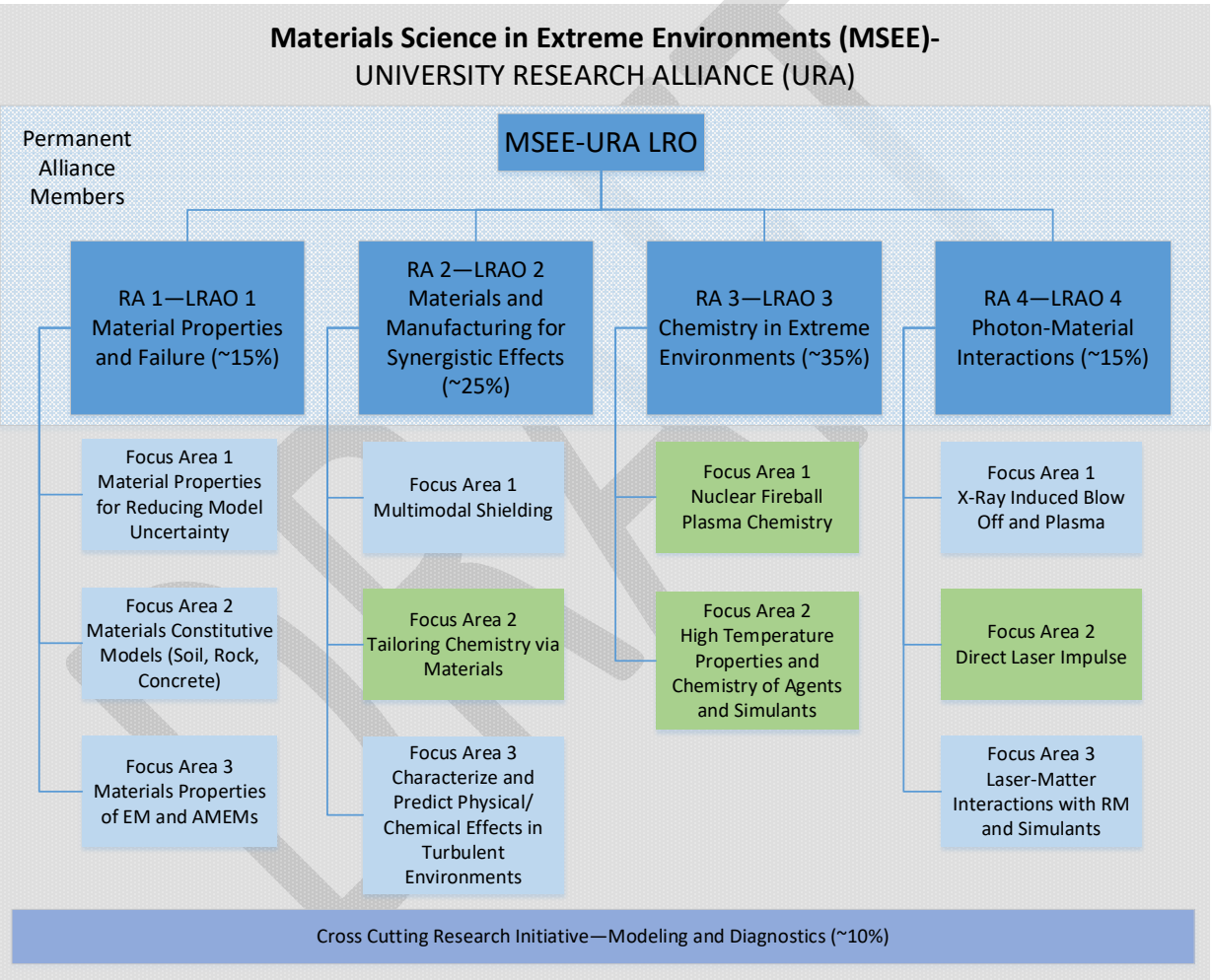


Figure 1: General structure of the MSEE-URA.

An expanded discussion of the FAs which would support the overarching research areas is included below.

1.3.1. RA1—Material Properties and Failure

RA1—FA1: Material Properties for Reducing Model Uncertainty

With the cessation of nuclear testing, high-fidelity computational modeling is a main mechanism

in supporting the nuclear deterrent through nuclear surety. Models and above ground simulators are also critical for assuring the nuclear survivability of DoD systems. Model results are sensitive to the underlying assumptions, solution method, initial conditions, and input data (e.g. material properties) which ultimately dictate the output quality and uncertainty levels. All of these factors contribute to the model result uncertainty at different times, magnitudes, and conditions further complicating and lowering result confidence.

MSEE seeks basic research into these computational factors that drive model and result uncertainty. Determining where the highest uncertainties exist and their overall effects on model fidelity is of interest to provide effective, focused, and high-impact material property and computational modeling research. Computational method shortfalls can also be considered and include, but are not limited to: numerical instabilities, material boundary instabilities, meshing and space discretization issues, assumptions, and competing/coupling of selected physics models. Of interest to the topic are materials in warm dense matter regimes and equations of state of non-heterogeneous materials.

MSEE also seeks to make experimental measurements for the material properties and conditions that are currently driving model uncertainty. Material properties of interest include, but are not limited to: equations-of-state (EOS), strengths, opacities, instabilities, and other kinetics properties used in computational modeling. Because experimental diagnostics for investigating material properties can be limited, basic research of new measurement methods and equipment are also welcomed.

RA1—FA1 References:

Colgan, J., Kilcrease, D. P., Magee, N. H., Sherrill, M. E., Abdallah Jr, J., Hakel, P., Guzik, J. A.,Mussack, K. A. (2016). A new generation of Los Alamos opacity tables. *The Astrophysical Journal*, *817*(2), 116. https://doi.org/10.1063/1.4975741

Guymer, T. M., Moore, A. S., Morton, J., Kline, J. L., Allan, S., Bazin, N., Benstead, J., Flippo, K. (2015). Quantifying equation-of-state and opacity errors using integrated supersonic diffusive radiation flow experiments on the National Ignition Facility. *Physics of Plasmas*, *22*(4), 043303. https://doi.org/10.1063/1.4919025

Hu, S. X., Collins, L. A., Goncharov, V. N., Kress, J. D., Boehly, T. R., Epstein, R., Skupsky, S. (2016, May). First-principles studies on the equation of state, thermal conductivity, and opacity of deuterium-tritium (DT) and polystyrene (CH) for inertial confinement fusion applications. In *Journal of Physics: Conference Series* (Vol. 717, No. 1, p. 012064). IOP Publishing. https://doi.org/10.1088/1742-6596/717/1/012064.

RA1—FA2: Material Constitutive Models (Soil, Rock, Concrete)

Offensive Counter-WMD operations currently rely on air-dropped ordnance that must penetrate or otherwise gain entry into WMD locations, which are frequently protected in underground or hardened storage facilities. As a result, Counter-WMD events occur at high strain rates (10^2-10^6 s^{-1}) where physical changes can take place on sub-microsecond time scales. Penetration, gaining entry to the WMD target, and weapon-target interactions (WTI) necessarily involve a wide variety of highly-heterogeneous materials under high dynamic loading conditions.

WMD-defeating systems are designed by using engineering hydrocodes that simulate weapon effects and WTI. The hydrocodes can produce accurate simulations only if high-fidelity constitutive material models are incorporated. Predicting the penetration trajectory of a weapon in concrete and various crustal-earth or manufactured materials require damage analysis of the crushing and cracking of materials. The final WTI requires accurate energy dissipation and stress propagation within these materials. Accurate energy dissipation should incorporate local

stress in mixed media, involving order-of-magnitude differences in local hardness or toughness.

The objectives of this effort are to understand the complex physical processes and multi-phase interactions between a higher velocity ballistic projectile and media such as unconsolidated granular sand or soil and earth media (e.g., rock or concrete).

This research seeks experimental and computational basic research to significantly improve our understanding of the effects of highly-dynamic compression, tension, and shear on highly-heterogeneous crustal and manufactured materials, fundamental material properties, material anisotropy, etc., which include but are not limited to: (i) experimental dynamic studies, with near-real-time visualization of damage under high dynamic load, especially for detailed study of the penetration/cavity expansion physical process, (ii) predictive physics-based models of the time-dependent interaction of overlying media (including intermediate layers) and high-speed penetrating bodies to include shock/pressure propagation, turbulent fluid flow, phase transition/change, etc., (iii) understanding of complex interaction processes such as the flow field around the projectile that governs penetration, (iv) formulation of predictive physics-based algorithms of the time-dependent interaction of granular and high-speed penetrating bodies to include shock/pressure propagation, turbulent fluid flow, material properties changes, etc., and, and (v) creation of concrete dust and energy evolution (e.g. absorption).

RA1—FA2 References:

Leong, A. F. T., Robinson, A. K., Fezzaa, K., Sun, T., Sinclair, N., Casem, D. T., Lambert, P. K., Hustedt, C. J., Daphalapurkar, N. P., Ramesh, K. T., Hufnagel, T. C. (2018). Quantitative In Situ Studies of Dynamic Fracture in Brittle Solids Using Dynamic X-ray Phase Contrast Imaging. *Exp. Mech. 58:*1423. https://doi.org/10.1007/s11340-018-0414-3

Parab, N. D., Guo, Z., Hudspeth, M., Claus, B., Lim, B. H., Sun, T., Xiao, X., Fezzaa, K., Chen, W. W. (2017) In situ observation of fracture processes in high-strength concretes and limestone using high-speed X-ray phase-contrast imaging. *Philosophical transactions of the Royal Society. Series A, Mathematical, physical, and engineering sciences, 375*(2085), 20160178. http://doi.org/10.1098/rsta.2016.0178.

RA1—FA3: Material Properties of Energetics Materials and Additively Manufactured Energetics Materials (AMEMs)

The goal of this FA is investigation of the factors which define the sensitivity of energetic materials. The focus is on the meso-scale origins of initiation, grain fracture, thermal hot spots, microstructural influence, etc. By understanding initiation mechanisms during penetration, energetic mixtures (including reactive materials) may be designed to enhance or control mechanical work and to minimize or eliminate combustion and pre-detonation during penetration.

However, little direct observation has occurred to show what causes the insensitivity of these materials. The main objective of this FA is to gain a clear understanding of the concepts that lead to reaction initiation of energetic composites as they undergo mechanical, thermal and chemical processes in impact (e.g. drop weight, shock) and non-impact events (e.g., static discharge). For impact events, the loading ranges of interest are peak pressures of 10-100 ksi, time durations of tens of milliseconds, and strain rates of 10^2 to 10^5 s^{-1}. Other programs focus on computational aspects of this problem.

MSEE seeks to experimentally interrogate the material properties effecting sensitivity of energetic composites, which could lead to building predictive models that will enable the efficient development of new energetics for the next generation of munitions for various mission

sets. Potentially, this effort would characterize the impact survivability of new formulations or composites and thus the overall design margin of the associated weapon system for a spectrum of hard targets. It is important to note that other government programs are focusing on computational aspects of this problem.

The goals of this effort include the following research objectives, but are not limited to: (i) experimental observations that describe microstructure or meso-scale features arising from chemical composition, particle size, morphology and the effect of processing techniques as a function of processing parameters; (ii) experimental observations that describe mechanical deformation and failure (both elastic and inelastic), that result in thermal and chemical reactivity of microstructure or meso-scale features; and (iii) characterize the effect of material properties, frictional forces and other parameters effecting initiation, thermal transport, and hotspot formation.

RA1—FA3 References:

Bondarchuk, S. V. (2018). Quantification of Impact Sensitivity Based on Solid-State Derived Criteria; *The Journal of Physical Chemistry A 122* (24), 5455-5463. https://doi.org/10.1021/acs.jpca.8b01743.

Ramos, K. J., Jensen, B. J., Iverson, A. J., Yeager, J. D., Carlson, C. A., Montgomery, D. S., Thompson, D. G., Fezzaa, K., Hooks, D. E. (2014). In situ investigation of the dynamic response of energetic materials using IMPULSE at the Advanced Photon Source. *J Phys Conf Ser, 500*(14):142,028. https://doi.org/10.1088/1742-6596/500/14/142028.

1.3.2. RA2—Materials and Manufacturing for Synergistic Effects

RA2—FA1: Multimodal Shielding

Nuclear command, control and communications (NC3) including aircrafts, ground vehicles, ships and transportable mission critical systems must be hardened against high altitude electromagnetic pulse (HEMP). HEMP is generated in high altitude nuclear detonation primarily by gamma ray's Compton interaction with air molecules. HEMP travels at the speed of light and is picked up by electrical conductors and antennas by the electromagnetic coupling. There are several phases of HEMP distinguished by the time of arrival. Firstly, the early time component (E1) of HEMP has a short duration of 1 μs with a high rise time of a few nanoseconds and can reach the intensity of several tens of kV/m. This is the most critical portion of the HEMP waveform with a high frequency of over several hundreds of megahertz dominated by the prompt gamma rays. Secondly, the intermediate time component (E2) of HEMP has an intermediate duration of 1 μs to 1 s from the effect of secondary gamma rays. Finally, the late time component (E3) of HEMP has a long duration of 1 s to several hundreds of seconds with a decaying waveform emanated from the interaction of Compton electrons with the Earth's magnetic field, which has similarities with the geomagnetic storm. The high frequency and amplitude of HEMP induce high current and voltage that can cause severe damage to electronic systems.

To protect against HEMP, Faraday cage principles are applied to form a continuous shielding enclosure that provides good electrical and magnetic conductive planes. Metal wires with good ferromagnetic properties are usually chosen to design a Faraday cage. However, these wires can be embedded in other materials to develop a composite material such as conductive concrete. Nanometals and nanofoams with better electrical and magnetic properties that are embedded in the composite matrix to create metal enclosure could also be considered for HEMP shielding. Another potential option is the use of conductive polymer composites for HEMP shielding. In

addition to HEMP protection, the goal of a shielding material is to provide protection against shock and penetration from conventional weapons.

MSEE seeks basic research in innovative multimodal shielding materials that provide protection from EMP in addition to blast, shock, and penetration. Nanoscale composites and networks, as well as higher order structures, are potentially of interest. Simply adding conductive material to known shielding materials is not generally of interest.

MSEE also seeks basic research on innovative approaches for fabrication and manufacture of multimodal shielding. Additive manufacturing could be a viable method of fabricating reinforced composite shielding materials. Methods to align and integrate a carbon nanotube network or other novel materials would also be of potential interest.

MSEE further seeks basic research in novel EMP shielding concepts. This could include directional EMP shielding that is or can be made transparent to desired electromagnetic signals without losing its functionality against EMP.

RA2—FA1 References:

Nguyen, L., Krause, A., Tuan, C., Blasey, J. D., Zemotel, J. P., McNerney, H., Metzger, F. J. (2017) Shielding effectiveness performance of conductive concrete structures, *2017 IEEE International Symposium on Electromagnetic Compatibility & Signal/Power Integrity (EMCSI)*. https://doi.org/10.1109/ISEMC.2017.8077895.

Zhang, H., Qiu, Z., Wang, H. (2018). Study on material of polymer-based electromagnetic shielding composites. *Materials Physics and Chemistry*.

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Holzworth K., Williams G., Guan Z., Nemat-Nasser S. (2013). Hybrid Polymer Grafted Nanoparticle Composites for Blast-Induced Shock-Wave Mitigation. In: Antoun B., Qi H., Hall R., Tandon G., Lu H., Lu C. (eds) Challenges in Mechanics of Time-Dependent Materials and Processes in Conventional and Multifunctional Materials, *Volume 2*(2013), Conference Proceedings of the Society for Experimental Mechanics Series. Springer, New York, NY. https://doi.org/10.1007/978-1-4614-4241-7_9.

RA2—FA2: Tailoring Chemistry via Materials

Chemical and Biological agents used as WMD are delivered as part of weapon payload systems. These agents exist in the form of solid (particulates), gas, liquid, mist (liquid droplets), etc., and are typically located in hostile or non-permissive areas in a wide variety of containers and facilities. Materials that will mitigate the above concern by utilizing multiple and synergistic mechanisms which lend themselves to performance control by tailoring energy/species output is preferred. Materials which produce combustion products with late time effects with pyrophoric characteristics are of interest (e.g., firebranding).

Prior efforts have focused on materials development for neutralizing biological agents in an ideal (standard pressure and temperature) environment. Efforts geared towards chemical agent pyrolysis and combustion have been limited and mainly focused on thermally driven decomposition pathways of several simulants with physical properties similar to a real agent. Within this FA, MSEE seeks basic research for identifying energetic and non-energetic material combinations capable of simultaneously neutralizing both biological and chemical agents in extreme environments and which utilize scalable manufacturing processes. As an example, employing additive processes techniques to explore the effect of geometry and composition on chemistry, kinetics, and control energy/species release is of great interest.

MSEE seeks research into the development of novel materials with synergistic effects producing simultaneous neutralization of CWAs and BWAs and their precursors by multi-mechanistic means and understanding of the decomposition chemistry in extreme environments. These environments include significant variations in pressure, temperature, moisture content, and key species concentrations (oxygen rich vs. oxygen deficient). Producing information on decomposition products to populate thermochemical/kinetic models is also of interest.

RA2—FA2 References:

Wang, H., Jacob, R., DeLisio, J., Zachariah, M. (2017). Assembly and encapsulation of aluminum NP's within AP/NC matrix and their reactive properties. *Combustion and Flame, 180*(175-183). https://doi.org/10.1016/j.combustflame.2017.02.036.

Harris, Russ. "The 7 Categories of Additive Manufacturing". Loughborough University Additive Manufacturing Research Group. Loughborough University. http://www.lboro.ac.uk/research/amrg/about/the7categoriesofadditivemanufacturing.

Stavrou, E., Zaug, J. M., Bastea, S., Crowhurst, J. C., Goncharov, A. F., Radousky, H. B., Armstrong, M. R., Roberts, S. K., Plaue, J. W. (2015). Equations of state of anhydrous AlF3 and AlI3: Modeling of extreme condition halide chemistry. *Journal of Chem. Phys, 142*, 214506. https://doi.org/10.1063/1.4921896.

RA2—FA3: Characterize and Predict Physical/Chemical Effects in Turbulent Environments

Novel energetic materials with thermal and chemical/catalytic neutralization mechanisms are being investigated for future defeat/denial scenarios. Reducing collateral effects using these novel materials requires accurate simulation of the relevant species and reactions followed by turbulent mixing and plume evolution. Recent advances by researchers have developed simulation models to describe some of the mechanistic phenomena; however, there is still a lack of understanding across the field as to how detonation/combustion products and key species interact in turbulent conditions with elevated temperature, pressure, and numerous species.

Further, predicting where and when the fireball or detonation products are hot (thermal profile) enough to neutralize agents, requires modeling the shock and detonation-induced instabilities leading to turbulent mixing. However, it is difficult to accurately characterize the highly-heterogeneous and dynamic post-blast environment due to lack of reliable experimental data, and computational and simulation models.

MSEE seeks to gain an understanding of turbulent mixing of aerosolized biological and chemical simulants in atmospheres of high temperature and reactive gases and catalytic particles. Research in computational fluid dynamics is needed to develop a novel approach to describe the mixing phenomena and ultimately neutralization. Investigation on functions that describe turbulence and experiments on small scale mixing are needed in time scales of 10-5000 ms. For future decision making purposes, MSEE seeks models describing turbulence and mixing dynamics in an extreme environment and includes quantification of measurement and model uncertainties.

MSEE also seeks tools and methods for dynamic imaging and characterization of post-combustion fields. Research in this area may lead to development of models and simulation tools to predict efficiency of neutralization mechanisms within a confidence interval given limited experimental data.

RA2—FA3 References:

Hawkes, E.R., Sankaran, R., Sutherland, J. C., Chen, J. H. (2005). Direct numerical simulation of turbulent combustion: fundamental insights towards predictive models. *J. Phys. Conf. Ser, 16*(65-79).

https://doi.org/10.1088/1742-6596/16/1/009.

Cabra, R., Chen, J. Y., Dibble, R. W., Hamano, Y., Karpetis, A. N., Barlow, R.s. (2003) Simultaneous laser Raman-Rayleigh-LIF measurements and numerical modeling results of a lifted turbulent H_2/N_2 jet flame in a vitiated coflow. *Proc. Combust. Inst. 29*(901-9). https://doi.org/10.1016/S1540-7489 (02)80228-0.

Smith, S. H. (1998). Mixing, structure and scaling of the jet in crossflow. *Journal of Fluid Mechanics, 357*(83-122). https://doi.org/10.1017/S0022112097007891.

Shaw, R. A. (2002). Particle-turbulence interactions in atmospheric clouds. Nov Annu. Rev. Fluid Mech. **18**(41183-227). https://doi.org/10.1146/annurev.fluid.35.101101.161125.

1.3.3. RA3—Chemistry in Extreme Environments

RA3—FA1: Nuclear Fireball Plasma Chemistry

Immediately after a nuclear detonation, complex chemical and physical processes take place in the fireball. The material from the device and the surrounding area interact as plasma, which eventually cools to produce a condensate of physical material as fallout debris. An in-depth understanding of the thermodynamics and kinetics within the fireball, including mixing of various materials present at a detonation site, and the resultant particle agglomeration, particle size distribution, chemical speciation, and other related phenomena of fallout formation at the extreme temperatures and pressures within and near the fireball at time scales extending from initiation to multiple seconds, is needed.

Currently, models such as DELFIC and HYSPLIT exist but increased fidelity will enhance the speed of response both in terms of fallout modeling and useful/effective debris sample acquisition. Of interest are innovations that will help provide more robust and accurate information used to predict the interaction of the fireball with the surrounding environment (including urban) and resultant fallout debris field. An increased understanding of fireball plasma chemistry has the potential to increase the accuracy of modeling and simulation for prediction of fallout plumes and debris fields.

This FA seeks a greater understanding of the complex chemistry and physics taking place shortly after a nuclear detonation. Breakthrough methodologies are sought to enhance our understanding of plasma chemistry and related processes inherent in a nuclear event fireball, from blast to fallout (suggested temperatures of 1 eV or lower). Research areas could include: thermodynamics; kinetics; mixing of surface material; particle agglomeration; particle size distribution; plasma chemistry; dusty plasmas, to include dusty plasma as a gas, nucleation, particle behavior; RF emissions affecting fallout in plasma; incorporating metastable states of elements into models; chemical speciation; levitation of targets; investigation of quantity of and temporal effects on material entering the vapor phase; and investigation of scalability of lab experiments to other experiments and models (i.e., temperature, pressure, laser energy, and duration). Research on nuclear weapons effects, nuclear weapons environments, and/or radionuclide environmental fate and transport could also be considered.

RA3—FA1 References:

Povh, B., Rith, K., Scholz, C., Zetsche, F., Rodejohann, W. (2015). Nuclear Thermodynamics. In *Particles and Nuclei* (pp. 373-400). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-46321-5_20.

Omrane, A., Petersson, P., Aldén, M., Linne, M. A. (2008). Simultaneous 2D flow velocity and gas temperature measurements using thermographic phosphors. *Applied Physics B, 92*(1), 99-102. https://doi.org/10.1007/s00340-008-3051-1.

Somasundaram, E., & Palmer, T. S. (2016). Analysis of the LIFT Variance-Reduction Method Applied to Monte

Carlo Radiation Transport Simulations of a Realistic Nonproliferation Test Problem. *Nuclear Technology, 193(3),* 391-403. https://doi.org/10.13182/nt15-43.

Weisz, D. G., Crowhurst, J. C., Finko, M. S., Rose, T. P., Koroglu, B., Trappitsch, R., Azer, M. (2018). Effects of Plume Hydrodynamics and Oxidation on the Composition of a Condensing Laser-Induced Plasma. *The Journal of Physical Chemistry A*, 122(6), 1584-1591. https://doi.org/10.1021/acs.jpca.7b11994.

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RA3—FA2: High Temperature Properties and Chemistry of Agents and Simulants

Counter-WMD operations in non-permissive or access-denied environments often rely on conventional weapons with energetic material payloads to defeat WMD targets. Current conventional weapons contain explosives and future custom-designed counter-WMD weapons will include reactive materials that continue to burn over longer periods of time than a conventional explosive. It is important to understand the effect of burning, variable heating rates, high temperature and temperature duration, on chemical agents that could be contained in a WMD target, and asymmetric heating rates arising in multi-room structures (thermal delay/shielding). MSEE is interested in determining the intermediate reactive species and final products that are formed as chemical agents/simulants/precursors are subjected to variable high temperatures and heating rates. MSEE seeks to understand the thermal degradation conditions, reaction routes, and kinetics of these species. It is important to consider if any thermal decomposition products or intermediate products are harmful or toxic. Further, since future weapons may contain reactive metals that burn to form metal oxides, sulfates that form sulfides, or halogenated oxides that form halogens, any enhanced effect from metal oxides, sulfides, halogens, etc., are also of interest. Additionally, consideration of more complex environments is also of interest (including concrete particulates and localized turbulent environments).

Although the primary interest within this FA is the high temperature chemistry, the high temperature physical properties and equation of state are also of interest. The research should cover high temperatures (300-2,000 K) and high heating rates (100-10,000 degrees per second). This includes characterizing the reactions, reaction mechanisms and kinetics of chemical agents/simulants/precursors when heated in the presence of metal oxides, sulfides or halogens at the same rates and temperatures stated above. Dynamic interrogation of the turbulent environment should cover a wide array of intermediate and decomposition species. Supporting high temperature spectroscopy of key species may be necessary to fully map the high temperature chemistry routes.

RA3—FA2 References:

Aly, Yasmine; Dalton, Allen; Peiris, Suhithi; 2015 Simulants Workshop Report, DTRA-IR-16-88.

Neupane, S., Barak, S., Ninnemann, E., Loparo, Z., Masunov, A., Vasu, S. (2018). Shock Tube/ Laser Absorption Experiments and Kinetic Modeling Study of Tri-Ethyl Phosphate (TEP) Combustion. *The Journal of Physical Chemistry A. 122*(3829-3836). https://122.10.1021/acs.jpca.8b00800.

Mathieu, O., Kulatilaka, W., Petersen, E. (2018). Shock-tube studies of Sarin surrogates. *Shock Waves*. https://doi.org/10.1007/s00193-018-0841-1.

Yuan, B., Eilers, H. (2018). T-jump pyrolysis and combustion of diisopropyl methylphosphonate. *Combustion and Flame, 199,* pp.69-84. https://doi.org/10.1016/j.combustflame.2018.10.013.

1.3.4. RA4—Photon-Material Interactions. Understanding the fundamental interaction of photons, especially high intensity photon pulses, with surface and near surface materials is

critical to both predicting the survivability of DoD systems to nuclear weapon effects as well as testing DoD systems in the absence of underground nuclear tests. Thermal (IR) photon pulses are of concern for endo-atmospheric and surface explosions and x-ray photon pulses are of concern for exo-atmospheric explosions. Recent developments in high energy pulsed lasers have also opened new opportunities for simulating nuclear effects for survivability testing and model verification. This research area focuses on creating, simulating, modeling, and measuring extreme environments using photons.

RA4—FA1: X-ray Induced Blow-off and Plasma

The majority of the energy in an exo-atmospheric nuclear explosion is released as an X-ray pulse. Due to the short penetration depth of X-rays in most materials, this X-ray pulse can cause the surface layers of a material to rapidly ablate, blow-off, and form a plasma. In addition to material surface damage and damage to exposed optics and sensors, this pulse can impart a shock wave on systems and potentially generate conductive plasmas on the surfaces of sensors or solar arrays. System level testing for X-ray effects is limited by source availability and vacuum requirements and additionally complicated by fast moving debris. Research in this area is expected to be predominately modeling and simulation informed by experiments as available and appropriate.

MSEE is seeking basic research on the fundamental interactions of x-rays with matter including: transport, penetration, blow-off, ionization and shock wave generation. Of particular interest is the time evolution and time dependence of X-ray interactions with matter. For example, the initial blow-off and plasma formation will change the opacities and energy absorption properties for the rest of the pulse duration. Time evolution is also critical to understanding and modeling shock generation, intensity, and timing/waveform.

RA4—FA1 References:

Fournier, K. B., Celeste, J., Rekow, V., Bopp, D. R., May, M. J., Fisher, J. H., Horton, R., Newlander, C. D., Jenkins, P., Trautz, K. (2010). A test cassette for x-ray-exposure experiments at the National Ignition Facility. *Review of Scientific Instruments, 81 (7).* https//doi.org/10.1063/1.3470684.

Hoheisel, R., Messenger, S. R., Lumb, M. P., Gonzalez, M., Bailey, C. G., Scheiman, D. A., Maximenko, S., Jenkins, P. P., Walters, R. J. (2013). Solar Cell Experiments for Space: Past, Present and Future. In Physics, Simulation, and Photonic Engineering of Photovoltaic Devices Ii, Freundlich, A., Guillemoles, J. F., *Eds. 2013; Vol. 8620.* https://doi.org/10.1117/12.2006087.

Jenkins, P. P., Trautz, K. M., Walters, R. J., Lorentzen, J. R., Fisher, J. H., Horton, R., Newlander, C. D., Davis, J. F., Seiler, S. W., Fournier, K. B., Rekow, V., Cho, B., Eskenazi, M. I. (2010). Nuclear weapons effects testing of solar cells using the national ignition facility (NIF). *In 35th IEEE Photovoltaic Specialists Conference 2010.* DOI: 10.1109/PVSC.2010.5614573.

RA4—FA2: Direct Laser Impulse

X-ray induced thermo-mechanical shock (TMS) from exo-atmospheric nuclear explosions can be a threat to DoD systems. Testing for TMS using X-rays is complicated by source availability, vacuum requirements, debris, and uniformity limits. Testing using explosives or magnet flyer plates is complicated by complex system shapes and limited availability. Pulsed laser based techniques have the potential to simulate X-ray blow-off and TMS. In this method, a tamper material is used as an interface between a laser beam and a test materiel. A tamper material is often adhesively bonded with the surface of a test sample to absorb the high energy more efficiently. The laser energy deposition in a tamper material forms a plasma ideally at the material tamper interface. The rapid expansion of hot plasma creates the impulse which in turn

generates shock waves in a test sample. This methodology of the generation of shock waves is promising to mimic the results from X-ray blow-off events in nuclear environments. The generated shock waves need to be measured and analyzed to study their impacts.

MSEE is seeking fundamental research on laser matter interactions to better understand energy deposition, plasma formation, and shock generation in tamper materials and adhesives.

MSEE is also seeking research for the development of novel tamper materials and application techniques for higher shock intensities and complex geometries.

MSEE further seeks research on models and simulations that better capture the relevant physics for predicting, tailoring, and optimizing direct laser impulse testing. Research should focus on the time evolution of laser energy deposition, plasma formation, and impulse generation. Impulse propagation and effects are not of interest to this area.

Finally MSEE seeks research on the novel non-invasive shock wave measurement techniques with capabilities of high frequency response and active measurements of longer duration in shock environments.

RA4—FA2 References:

Paisley, D. L. (2006). Confined plasma ablation for shock physics, plate launch, and material dynamics, *Proc. SPIE 6261, High-Power Laser Ablation VI, 62611Y*, 14 June 2006. https://doi.org/10.1117/12.674773.

Cranch, G. A., Grun, J., Weaver, J., Gran, J. K., Groethe, M. A., Compton, S., Fournier, K., Dunlop, B. (2015). High Power Laser and Explosive Driven Shock Wave Characterization in Solids Using Fiber Optic Probes, *24th International Conference on Optical Fibre Sensors (OFS)*, Curitiba, BRAZIL, Sep 28-Oct 02; Curitiba, BRAZIL, 2015. https://doi.org/10.1117/12.2193907.

Paisley, D. L., Luo, S. N., Greenfield, S. R., Koskelo, A. C. (2008). Laser-launched flyer plate and confined laser ablation for shock wave loading: Validation and applications. *Review of Scientific Instruments, 79* (2). https://doi.org/10.1063/1.2839399.

Schmitt, M. J., Kopp, R. A., Moore, D. S., McGrane, S. D. (2004). Analysis of laser-driven shocks in confined and unconfined geometries. *In Shock Compression of Condensed Matter - 2003, Pts 1 and 2, Proceedings*, Furnish, M. D., Gupta, Y. M., Forbes, J. W., Eds. 2004; *Vol. 706*, pp 1409-1412. http://dx.doi.org/10.1063/1.1780502.

RA4—FA3: Laser-Matter Interactions with Reactive Materials and Simulants

Prompt defeat of agents relies heavily upon energetic systems creating conditions for thermal decomposition or chemically generated reaction pathways, both leading to neutralization of the agent. This FA is intended to investigate mechanisms generated via controlled interaction between optical frequencies and energetic/non-energetic systems containing reactive material (composites) and organohalide/organophosphorus molecules.

Current laser technologies offer significant control of optoelectronic interactions with materials and molecules (e.g. wavelength, fluence/intensity, phase control, etc.). Lasers offer the potential for controlled decomposition of molecules (including organohalide and organophosphorous species). MSEE seeks to understand the limits of photo-induced control for decomposition and reactions involving reactive materials (composites) and chemical/biological simulants. Better understanding of these photo-controlled processes may lead to new understanding of potential reaction pathways and formation of possible toxic intermediates/products. Understanding these processes under atmospheric scale (non-vacuum) conditions is of interest.

MSEE is looking into alternative ways to harness laser-matter interactions (LMI) to create alternative environments that are not conducive to agent/simulant survival. The emphasis here

will be in understanding control of physical mechanisms and reaction routes involving coherent photons, with reactive materials (composites) and threat simulants. MSEE seeks research into using coherent photons to control the decomposition pathways of organo-halide molecules and those interacting with organophosphorus agent simulants and coated spore simulants.

RA4—FA3 References:

Gottfried, J. (2018). Laser-induced air shock from energetic materials (LASEM) method for estimating detonation performance: Challenges, successes and limitations. *AIP Conference Proceedings, 1979*(1):100014. https://doi.org/10.1063/1.5044886.

Davari, S. A., Gottfried, J., Liu, C., Ribeiro, E., Duscher, G., Mukherjee, D. (2018). Graphitic coated Al nanoparticles manufactured as superior energetic materials via laser ablation synthesis in organic solvents. *Applied Surface Science, 473*(156-163). https://doi.org/10.1016/j.apsusc.2018.11.238.

Roos, E.V., Benterou, J.J., Lee, R.S., Roeske, F., Stuart, B. (2002). Femtosecond laser interaction with energetic materials. In*: Phipps CR (ed) Proceedings of the SPIE 4760*, high-power laser ablation IV, Taos, NM, Sept 9, 2002. Society of photo-optical instrumentation engineers (SPIE) Conference Series, *vol. 4760 SPIE*, p 415. https://doi.org/10.1117/12.482111.

1.3.5. CCRI—Modeling and Diagnostics. The central theme of MSEE is focused on materials and material interactions within dynamic, local, extreme environments. Critical to understanding those interactions is having the computational and experimental tools to evaluate/characterize/quantify materials and processes. Hence, computational modeling and diagnostics were identified as a CCRI.

Development of computational modeling has led to increased success in making new discoveries and driving technological achievement. The ability to simulate a large number of experiments while controlling for many variables provides an exceptional amount of information about the behavior and properties for matter much faster than trial and error. Although computational approaches have limitations, it can provide an explanation for the underlying fundamental mechanisms of observed experimental results.

MSEE envisions the development of models and diagnostics to focus on calculating properties of materials, material reactions, and temporal evolution of the immediate environment during WMD and C-WMD events. Possible types of models to be researched may include, but are not limited to: reduced ordered modeling; dynamic mode decomposition; and uncertainty assigned (or UQ) to physical parameters that are theoretically modeled. Since the basis of using these models to determine material characteristics is similar, there should be a central coordinated effort to share and work on the model codes with other participating members. In addition, modeling alliance members are expected to collaborate in the validation of models and diagnostics through experimental work at other alliance institutions.

Similarly, dynamic characterization will provide information for modeling and simulation efforts, from microseconds to seconds of the expanding fireball. Possible parameters of interest include species concentrations, chemical identification and temperature field using linear and nonlinear optical techniques appropriate for characterizing species, species concentrations, and optically thick, particle laden flow fields. In order to fully understand the WMD and C-WMD environments, MSEE is interested in the reconstruction of dynamic events with high spatiotemporal resolution. As an example, for the case of a blast of an energetic material and simulant, measurements and algorithms such as tomographic absorption for multi-species tracking is of interest.

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1.4. Structure and Management

It is critical that the MSEE-URA be structured and managed to create and foster an open, collaborative research environment. This section describes a framework for the organization of the MSEE-URA. The lightweight framework is flexible to minimize overhead, yet ensure research relevance and proper oversight. Applicants can suggest additional management tools and mechanisms as part of the proposal, but in doing so they must also justify and demonstrate the benefit and cost effectiveness of these additional management activities.

DTRA and the MSEE-URA will collectively be referred to as the MSEE-Consortium. Other Government agencies may be invited to join the MSEE-Consortium and to contribute, as appropriate, their technical expertise, personnel, access to research facilities, and funding. Given that the research program may be enhanced during the lifetime of the CA, applicants should suggest a procedure for how the enhanced program may be considered and incorporated by the MSEE-URA.

The MSEE-URA will strive for a focused, yet flexible research environment. The MSEE-URA will be led by a single U.S. institution of higher education that will be designated as the LRO. The LRO will be charged with spearheading the focused basic research program and must have the ability to integrate the broad palette of research required to realize the goals of the MSEE-URA. Each RA will be led by a different Lead Research Area Organization (LRAO); each LRAO will be a U.S. institution of higher education. One of the LRAOs could also be the LRO; however, the same entity cannot be the LRAO for more than one RA. Together the LRO and LRAOs make up the permanent members of the MSEE-URA, who together are responsible for shaping and steering the Alliance through collaboration with DTRA. Collectively, the URA members and DTRA make up the MSEE-Consortium.

Performance under the CA may also include additional organizations (over and above the LRO and LRAOs) as subawardees to round out the technical expertise and research tasks in a given RA. Any such organizations are expected to be subawardees to the LRO and will be considered as non-permanent members of the MSEE-URA. The non-permanent members of the URA may consist of U.S. institutions of higher education, DoD Service Laboratories, DoD Degree-Granting Colleges and Universities, Department of Energy (DOE) Laboratories, U.S. industrial partners, and/or U.S. non-profit organizations possessing the required expertise. Given the likelihood that the non-permanent members will change over the lifetime of the CA, applicants should suggest a process for consideration and incorporation of new organizations into the research program.

Alliances are encouraged to include Historically Black Colleges and Universities (as determined by the Secretary of Education to meet requirements of Title III of the Higher Education Act of 1965 as amended, 20 U.S.C. § 1061) and from Minority Institutions defined as institutions "whose enrollment of a single minority or a combination of minorities…exceeds 50 percent of the total enrollment," 20 U.S.C. § 1067k(3).

1.4.1. Technical Guidance and Oversight. The following framework is required for the management and oversight of the MSEE-Consortium. Applicants may propose additional plans or mechanisms for management; however, applicants are cautioned to ensure that any such plans or mechanisms are: (1) not duplicative of the requirements and (2) not overly burdensome to the Alliance. A description of each component of the MSEE-Consortium management follows:

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- Cooperative Agreement Manager (CAM). The integrated scientific management and fiscal responsibility for the URA will reside with the DTRA Basic Research Manager, who will be designated the CAM for the MSEE-URA under the CA. The Grants Officer will receive recommendations from the CAM and will be the ultimate legal authority empowered to make formal modifications to the CA.
- Technical Points of Contact (TPOCs). The TPOCs are the government subject matter experts (SMEs) that are charged with the scientific stewardship of the RAs and CCRI. Each RA will have a DTRA TPOC. The TPOCs will work collaboratively to lead the CCRI efforts. The TPOCs will be heavily involved in the scientific management and review of the MSEE-Consortium. The TPOCs will have significant responsibilities in the development of the Initial and Biennial Program Plans (IPP/BPP); fostering deep and persistent multidisciplinary research across the RAs; and performing day-to-day administrative duties associated with the RAs. The TPOCs will be the advisors to the CAM.
- Lead Research Organization (LRO). The LRO provides the overall research leadership for the Consortium. This responsibility includes the day-to-day management of the MSEE-URA; oversight of the development of the IPP/BPP; participation in the research; promoting collaboration and technology transition; distributing Government funding to permanent and non-permanent members of the Alliance; and maintaining proper research invoicing. The LRO will designate a Program Manager (PM) from their organization who will be the Alliance's scientific and programmatic representative charged with providing management and guidance of the CA.
- Program Manager (PM). The MSEE-URA PM is the LRO's scientific representative charged with the Alliance's overall responsibility for management and guidance of the CA. The PM is required to be an eminent scholar in the field of physical sciences or engineering (e.g. Physics, Chemistry, Materials Science, or Mechanical/Chemical Engineering, etc.) and have the stature, experience, and leadership skills to successfully execute the MSEE-URA. It is also recognized that the PM may require staff support to manage and execute the CA, and this staff support should be included in the proposal submission.
- Lead Research Area Organizations (LRAOs). The LRAOs provide research leadership for a specific Research Area (RA). This responsibility includes supporting the PM in the development of the IPP/BPP; creating and fostering deep and persistent multidisciplinary research across the RA; performing day-to-day administrative duties associated with the RA; and conducting fundamental research in support of the MSEE-URA. Each LRAO will identify a specific Principal Investigator to represent the LRAO, as a Research Area Lead (RAL), in Consortium planning and execution and to serve as a member in support of the PM and CAM during TMG meetings. If the LRO is also a LRAO, the PM and the RAL must be different individuals.
- Technical Management Group (TMG). The TMG is chaired by the CAM and consists of the PM, the four RALs, the corresponding RA Government TPOCs, and the DTRA Chief Scientist. The TMG will collaboratively lead the Consortium and assist the CAM and the PM in carrying out their duties concerning the MSEE-URA. The RALs and their respective Government RA leads will collaboratively lead the RAs through the TMG.

The TMG will be responsible for the management and integration of the Alliance's efforts including programmatic, technical, reporting, financial, and administrative matters. In matters where a consensus cannot be reached amongst the TMG, the CAM will have final decision-making authority. The TMG makes recommendations that concern the membership of the Alliance, the definition of the tasks and goals of the participants, and the relative distribution of funding to the members and subawardees. Quarterly meetings will be conducted by the TMG; meetings may rotate among Alliance locations and some may be accomplished virtually.

- Research Management Board (RMB). The RMB will be established by the CAM to identify and develop collaborative opportunities, advise and assist the CAM in setting research goals by providing advice into the BPP planning process, provide recommendations to the CAM for the option year execution, and facilitate transition of URA research to basic and applied research programs. The RMB will be chaired by the CAM and may include the DTRA Chief Scientist, the TPOCs and other representatives from DTRA. Other service organizations and other Government agencies with interest and expertise in the technologies related to the MSEE-URA may also be included at the discretion of the CAM. The RMB will be invited to the Technical Review and appropriate workshops. The RMB will also be invited to review the IPP and BPP.

1.4.2. Articles of Collaboration (AoC). The AoC define the operational structure and governance within the Alliance including:

- Membership and management
- Changes to Consortium membership
- Financial, personnel, facilities, and reporting requirements
- Intellectual property
- Information exchange guidelines
- Modifications to the AoC

Applicants invited to submit a proposal will be provided a model AoC with their invitation to submit a proposal. The model AoC represents appropriate and necessary terms and conditions that the Government finds acceptable for operation of the MSEE-URA. Applicants must submit the AoC with the proposal signed by a duly authorized representative for each proposed member of the Alliance. The model AoC can be executed by the proposed members of the Alliance "as is" or changes can be proposed. If changes are proposed, applicants are hereby informed that justification of any changes should be included with the proposal and such changes must be acceptable to the Government for the applicant to be eligible for award.

1.4.3. Initial Program Plan (IPP). Within 90 days after award, the PM will prepare an IPP through the TMG to cover the following 9-12 months of performance. The IPP will be based substantially on the draft IPP submitted as part of the proposal from the Alliance. The IPP should provide a detailed description of well-coordinated research activities. The IPP will contain a Data Management Plan as an appendix.

The IPP should be accompanied by a nine-year roadmap that describes the overarching goals and objectives to be accomplished by the Alliance within the Consortium structure. This roadmap

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should provide the vision for goals to be addressed during the first five years of the Alliance and similar for the two additional two year option periods. It should provide approximate timelines for research activities to facilitate potential future basic research transitions.

The IPP and the roadmap will be submitted to the CAM for review and approval. The final, approved IPP will be submitted to the Grants Officer for incorporation into the CA.

1.4.4. Biennial Program Plan (BPP). Nine to 12 months after award, the PM will prepare a proposed BPP through the TMG for the next two fiscal years. The BPP will enable integration and execution of multidisciplinary, collaborative research that strives to achieve URA objectives.

The BPP will provide a detailed plan of research activities (including research goals, key personnel, collaboration opportunities, staff and student development opportunities, facilities, experiments and budget) that commits the Alliance to use their best efforts to meet specific research objectives. The BPP will also describe the collaborative efforts with the Government. The BPP will include a detailed description of the projects proposed to be undertaken by any subawardees, including new subawardees. The BPP will contain the Data Management Plan as an appendix.

The BPP will be submitted to the CAM for review and approval. The final, approved BPP will be submitted to the Grants Officer for incorporation into the CA. This process will continue through the life of the CA. Each BPP will cover a two-year timeframe, but may be altered, with the approval of the CAM and the Grants Officer, if research work requirements change.

During the course of performance, if it appears that research goals will not be met, the TWG will provide a proposed adjustment to the BPP for approval by the CAM. In addition, the CAM may from time to time request that additional research be added to the BPP within the scope of the CA. The Alliance, as an entity, will not solicit or accept funding from outside sources other than DTRA without the approval of the CAM and the Grants Officer.

During the course of performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the IPP/BPP including but not limited to:

- Changes in the scope or the objective of the program, IPP/BPP, or research milestones;
- Change in the key personnel specified in the IPP/BPP;
- The absence for more than three months, or a 25% reduction in time devoted to the project, by the URA PM;
- The need for additional Federal funding; and
- Any subaward, transfer, or contracting out of substantive program performance under an award, unless described in the IPP/BPP.

1.4.5. Annual Technical Review Meeting. Each year, the MSEE-URA must conduct a Technical Review that is open to the scientific community at-large where the research portfolio is presented by the PIs. Such a review is intended to allow the Alliance researchers to engage in face-to-face technical discussions as well as garner input on the technical achievements of the Alliance from the broader community. One goal of this meeting is to foster interactions and collaborations among researchers and allow Consortium research leadership to assess research progress. The emphasis for the review is on collaborations (especially multi-disciplinary, cross-RA collaborations), experimentation/validation plans, and possible transition opportunities.

Planning for the annual Technical Review Meeting will be conducted by the TMG. The annual Technical Review Meeting will be executed by the Alliance. A hosting rotation between the permanent Alliance members and DTRA is encouraged.

DTRA strongly encourages student and post-doctoral fellow participation in the annual technical review meetings. It is, however, recognized that such participation must be balanced with the associated costs. Thus, DTRA anticipates that a significant number of the students and post-doctoral fellows will participate in each review. DTRA also anticipates that the Alliance will consider site rotation and inclusion of more advanced research in selection of student and post-doctoral fellows for review participation. To ensure development of student and post-doctoral fellows the review must include targeted avenues for them to explore collaboration and networking opportunities and share their research, e.g., through poster presentations or oral sessions.

Applicants should suggest a model with an associated cost for the conduct of annual reviews of the research program that meet the intent of what is described herein.

1.4.6. Additional Information. It is anticipated that the Alliance will participate in other DTRA program reviews.

The MSEE-URA, as an entity, will not solicit or accept funding from outside sources without the approval of the CAM and the Grants Officer.

The CAM, in coordination with the RMB and DTRA leadership, will be responsible for integrating the IPP/BPP into the overall Government research and technology programs. During the course of performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the CA including, but not limited to:

- Changes to the AoC if such changes substantially alter the relationship of the parties as originally agreed upon;
- Solicitation or acceptance of funding under the agreement from sources other than DTRA; and
- Changes in non-permanent Alliance membership, if not documented in the IPP/BPP.

1.5. Collaboration and Workforce Development

A close collaborative relationship between DTRA and the Alliance will be necessary to accomplish the research for the MSEE-URA. Persistent collaboration across the MSEE-URA will enhance innovation and have a high return on investment. It is DTRA's strong belief that work conducted under the MSEE-URA cannot be successful either in whole or in part without collaboration. DTRA intends for the collaboration to provide avenues to promote growth and development of staff across the MSEE-Consortium, including Government personnel. Particularly of interest to DTRA is training the “next-generation” of SMEs. DTRA also views the collaboration as a means to foster a community with both high-value technical expertise and insight into DTRA challenges. Therefore, collaboration between the Alliance and the Government is integral to the execution and success of the MSEE-URA. Creation of an environment that is conducive to collaboration is a critical element in establishing the Alliance. In the proposal, applicants should outline the range of opportunities foreseen for collaboration and the mechanisms that will be put into place to foster the collaborative activities.

1.5.1. General Activities. The URA is encouraged to hold regularly-scheduled scientific lectures, conduct short courses, convene RA-focused technical meetings, and technical workshops on mutually agreed upon topics throughout the period of performance. Additionally, the MSEE-URA is expected to hold regular, periodic research reviews that will permit and encourage the free exchange of ideas and research results, especially those impacting any crosscutting research themes. Alliance PIs may be invited to give a seminar at DTRA up to four times a year for the duration of the CA. Likewise, DTRA personnel may give seminars at Alliance locations. Importantly, these activities should include opportunities for young Alliance investigators (PIs within five-years of their PhD), students, and post-doctoral research fellows to participate in a meaningful way. The activities will serve as educational opportunities for all Alliance members, including students and post-doctoral research fellows, provide additional collaboration opportunities, and provide a mechanism for inclusion of the broader community of interest. Thus, consideration should be given to involvement of participants outside the Alliance when appropriate.

1.5.2. Staff Rotations. An important element of MSEE-Consortium collaboration is the advancement, education and rotation of technical staff through short- and long-term temporary assignments across the Alliance. Staff rotations may include DTRA personnel rotating to Alliance facilities. The scope of this collaboration may range from regular, periodic short-term visits to sabbaticals lasting as long as a year. Staff rotations will be undertaken to foster and facilitate collaborative research where face-to-face interaction is advantageous, to enable a researcher to utilize unique facilities, to enable Alliance personnel to obtain specialized training or experience and to facilitate the exchange of research results. There should be a balance of staff rotations across all the partners in the Alliance and across all the research areas. Student and post-doctoral research fellow participation in staff rotations is strongly encouraged.

In addition, this exchange of personnel will provide Alliance personnel with insight into DTRA-unique requirements and will provide Government personnel with insight into MSEE research and/or the opportunity to pursue fundamental research with noted researchers.

All salary and travel costs associated with the rotation of Government personnel will be borne by the Government. All salary and travel costs associated with staff rotations of Alliance members will be funded under the CA or may be provided by the Alliance member as cost-share; it is anticipated that some portion of the Alliance's scientific labor-years will be in staff rotations.

1.5.3. Electronic Resources. The Alliance is expected to host a web-based repository of information from the MSEE-URA that is accessible by Consortium stakeholders for the duration of the MSEE-URA CA. This repository will include programmatic and review material. It will also serve as a vehicle for software and dataset sharing. As such, applicants should note the requirement for a Data Management Plan to be developed as part of the IPP process, and revisited through the BPP process. Upon completion of the CA, it is expected that end-to-end documentation will be delivered to the Government for record keeping, e.g. technical review materials, meeting minutes, reports, etc. Applicants should also consider other electronic and web-based avenues to promote the Alliance to the larger community of interest. Minimally, DTRA anticipates that the Alliance will publish and distribute a newsletter at least annually detailing research results, technical impacts, and collaboration activities.

1.5.4. High Performance Computing DoD Supercomputing Resource Center (HPC-DSRC). The DoD High Performance Computing Modernization Program (HPCMP) provides

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computational resources through DoD Supercomputing Resource Centers (DSRCs) (https://centers.hpc.mil/users/centers.html). The MSEE-URA partners can request access to resources at one or more DSRCs under the MSEE-URA umbrella to utilize the computational and visualization resources. There are five DSRCs. These centers provide DoD scientists and engineers with the resources necessary to efficiently solve the most demanding computational problems. The HPCMP delivers the latest in computational tools, visualization and innovative technology. The DSRCs' modeling and simulation environment enables research, helps subject matter experts engineer, develop, test, and field weapon systems faster and more efficiently. The DSRCs offer a full spectrum of computational capabilities for the DoD Science and Technology and Test and Evaluation communities, including:

- Powerful parallel processors
- Reliable high-speed networks
- A wide range of software
- Comprehensive storage
- Scientific visualization
- Close ties with academic partners
- Advanced training
- Outstanding end-user care

1.5.5. Other. While primary paths for the collaboration with DTRA will be through the TMG, the IPP/BPP process, the annual technical review meeting, and activities suggested herein, applicants are strongly encouraged to suggest additional new and innovative avenues for fostering collaboration within and external to the Consortium. The costs associated with these activities will be funded under the CA.

1.6. Enhanced Program

Should the MSEE-URA be of interest for DTRA Budget Category 6.2 funding (Applied Research funding) or to other funding agencies, an unfunded Enhanced Program is included in this BAA. This is intended to provide a mechanism for growth and enhancement within the URA. DTRA and/or other Government agencies may choose to support the program with basic and/or applied research dollars in areas of specific interest to their basic and applied mission programs. This enhanced program will leverage parallel and/or transition the research, technology and capabilities that are the core of the DTRA funded URA. Applicants are not to include the Enhanced Program discussion in the Phase I pre-proposal submission. Applicants invited to submit a Phase II proposal should include a general discussion of possible ways to develop and source Enhanced Program projects.

1.7. Program Metrics

DTRA anticipates that the MSEE-URA performance metrics will include items like the following: technical accomplishments, the number and quality of refereed journal and conference articles, invited presentations, patents, relevance of the work to DTRA, collaborations, student development, and staff rotations. The success of the interactive and collaborative portion will be assessed by the quality of the collaboration as demonstrated by joint

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efforts such as basic research transitions to applied research programs, archival journal papers, patents, and refereed presentations.

2. FEDERAL AWARD INFORMATION

2.1. Award Types

DTRA anticipates that a single CA may be made from this BAA. The Government actions under this BAA shall adhere to the requirements of 2 CFR Part 200, as modified and supplemented by DoD's interim implementation found at 2 CFR Part 1103 and the DoD Grant and Agreement Regulations (DoDGARs).

The Government reserves the right to fund all, some, or none of the proposals submitted; may elect to fund only part of any or all proposals; and may incrementally fund any or all awards under this BAA. An award may be made to the Alliance that offers the best value to the Government. Applicants must recognize and understand that there are no guarantees any award will be made or, if an award is made, that it will be for the levels of funding detailed in Table 1. The Government also reserves the right to request applicants make any changes necessary to submitted full proposals to increase the feasibility of making the proposal fundable. Applicants may decline to participate in any revisions to application packages requested by DTRA. Alliance members may be expected to compromise and sacrifice anticipated funding to their organization as necessary and appropriate to meet the goals and objectives of the MSEE-URA as established through the collaborative planning process.

2.2. Subawards

Subawards are permitted. The permanent Alliance membership may be augmented with subawardees to meet the research objectives of the MSEE-URA, especially for the conduct of new and innovative research for which they are particularly qualified. Subawardees are organizations that (1) are not expected to provide strategic input concerning the goals and direction of the MSEE-URA and (2) may possibly have only a short-term relationship with the Consortium. Subawardees are non-permanent members of the Alliance and may change over the lifetime of the CA.

The LRO will distribute the funding to all Alliance members and subawardees. Subawardees beyond the LRAOs will be considered non-permanent members of the Alliance and may change over the duration of the CA as necessary to meet the research goals detailed in the IPP and the BPP.

2.3. Award Values

The CA may range from $5M to $7M annually (total, including both direct and indirect costs) depending on the nature and the scope of work. The funding includes all known costs associated with the CA, i.e. the costs for research, program management, experimentation, travel, outreach, etc. The key assumption is that the CA will be awarded in the 1st quarter of Fiscal Year (FY) 2020 with approximately 20% of requested first year funds. Additional information may be provided in the letter of invitation for Phase II proposals.

All awards are subject to the availability of funds. Additional guidance regarding award values may be provided in invitations to submit a Phase II application package. Any specific guidance provided to an applicant supersedes the information provided herein. Funding for participation in this program is highly competitive and the cost of proposed research should strictly be

maintained as detailed herein or as indicated in the invitation instructions.

2.4. Period of Performance and Award Structure

Any CA resulting from this BAA will be awarded for a five-year base period. There will be two options to extend the CA for an additional two years each. The total potential period of performance under the CA will be nine years.

Prior to the end of the fourth year, a comprehensive program review will be conducted as directed by DTRA. This review will consider cumulative performance metrics, the Consortium's vision for each of the option periods of performance (to be submitted by the Consortium prior to the end of the fourth year), funding availability and the current research needs and goals of DTRA. The decision as to whether to exercise the first option is expected to be based on the results of the base period review and evaluation described above. A similar process will be followed for the second option period.

2.5. Hardware and Software

The Government does not anticipate the need to provide any hardware or software to execute the proposed research. However, DTRA will review and consider any hardware/software requests for all Phase I pre-proposals and invited Phase II proposals on a case-by-case basis.

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3. ELIGIBILITY INFORMATION

3.1. Lead Research Organization (LRO)

Phase I and Phase II application packages submitted in response to this BAA will be considered from accredited U.S. degree-granting colleges, universities, and academic institutions. The URA must be led by a U.S. institution of higher education with doctoral-level courses of study in scientific and research areas related to MSEE that can result in the granting of a doctoral degree. This organization will be designated as the LRO and will have specific leadership and management responsibilities, including but not limited to the following:

- The LRO is expected to articulate a vision for the MSEE-URA, promote collaboration among consortium members, and coordinate crosscutting research themes.
- The LRO is required to administer the MSEE-URA, participate in the research, and promote the transition of research and technologies resulting from the research program.
- The LRO is responsible for distribution of Government funding to consortium members and subawardees in accordance with the approved IPP/BPP. The LRO is also responsible for timely billing (invoicing) of executed research for itself and the other Alliance members to ensure proper disbursement of Government funds.

3.2. Lead Research Area Organization (LRAO)

Each RA will be led by a different LRAO, one of which may also be the LRO; the same entity cannot be the LRAO for more than one RA. Each LRAO must be an accredited U.S. degree-granting college, university, or academic institution. Each must possess substantial experience and expertise in the associated RA. Institutions of higher education are expected to have doctoral level courses of study in scientific and research areas related to this URA that can result in the granting of a doctoral degree.

3.3. Subawardees

U.S. institution of higher education, DoD-Degree Granting Colleges and Universities, DoD Service Laboratories, Federally-funded research and development centers (FFRDCs) to include DOE National Laboratories, U.S. industrial partners, and U.S. non-profit organizations may be considered as subawardees.

3.4. Limits to Alliance Membership

DTRA anticipates that an optimally sized consortium, to include the non-permanent subawardees, would be approximately eight-12 organizations, but this should not be considered a hard limit. Phase I and Phase II application packages that include significantly more than eight-12 organizations must provide a rationale for the additional members.

DTRA anticipates that not more than 40% of the total dollar value of the effort annually will be maintained at the LRO for the conduct of research. DTRA also anticipates that if the LRO is not also a LRAO a minimum of 15% of the total dollar value of the effort annually will be maintained for the conduct of research at the LRO. DTRA anticipates that researchers from the LRO and LRAOs will participate in the research undertaken across the RAs.

Applicants should note that DTRA expects that a minimum of 60% of the total dollar value of the effort annually must be dedicated to participation of accredited U.S. degree-granting colleges, universities, and academic institutions. Thus, applicants are expected to consider carefully the construct of their proposed consortium and effectively engage the appropriate membership and subawardee performance to achieve the goals of the Alliance as detailed in this BAA.

Allocation of any funds received via the enhanced program will be considered on a case-by-case basis.

3.5. Cost Sharing or Matching

Cost sharing is not required under this BAA; however, efforts that include cost sharing or in kind contributions are encouraged. During the evaluation of proposals, any cost sharing or in kind contributions will be evaluated as it relates to the evaluation factors listed in the BAA, based on the degree to which the proposed cost sharing or in kind contributions enhance the proposal to result in added benefits to the MSEE-URA. To allow for evaluation of a proposed cost sharing or in kind contributions, a proposal should express a firm commitment to provide such cost share or in kind contributions and evidence a process for integrating the same into the collaborative research program.

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4. APPLICATION AND SUBMISSION INFORMATION

4.1. Address to Request Application Package

This announcement contains all information required to submit a Phase I pre-proposal package and an invited Phase II proposal package. The required application packages for Phase I and invited Phase II submissions are posted with this announcement. The application packages posted to www.grants.gov consist of the forms as detailed in Table 1.

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Form Name	Phase I Pre-Proposal Application Package	Invited Phase II Proposal Application Package
SF-424 (R&R) Application for Federal Assistance Form	Required	Required
RR Budget Form	N/A	Required
R&R Subaward Budget Attachment(s) Form(s)	N/A	Required
Research & Related Senior/Key Person Profile Form	Required	Required
RR Personal Data	N/A	Required
Research & Related Other Project Information	N/A	Required
Disclosure of Lobbying Activities (SF-LLL)	N/A	If Applicable
Attachments Form	Required	Required

Table 1: List of forms in the Phase I and Phase II application packages. The instructions for completing each of these forms may be found online at the following web link: http://www.grants.gov/web/grants/form-instructions.html.

4.2. Content and Form of Application Submission

Submissions for this BAA will be conducted in two phases. Phase I is for receipt of pre-proposal packages. Phase II is for receipt of invited proposal packages. Invitation to submit a Phase II proposal will be based on the evaluation results of the Phase I pre-proposal submission.

4.2.1. Electronic Submissions. Phase I and Phase II packages and attachments **must be** submitted electronically using www.grants.gov and the corresponding application packages linked with this BAA on www.grants.gov (under the "Packages" tab). All applications, including all supporting documents, must be submitted in the English language.

Applicants are responsible for ensuring compliant and final submission of their Phase I and invited Phase II packages. Note that this also applies to applicants using third party systems to submit application packages and attachments. Any submission that does not conform to the requirements outlined in the BAA and in the invitation for Phase II participation may not be reviewed or considered further at the discretion of DTRA.

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4.2.2. Phase I Pre-Proposal Submission. Each Phase I application package contains the forms detailed in Table 2.

Form	Attachment	Action
SF-424 (R&R) Application for Federal Assistance Form	N/A	Enter the appropriate information in data fields
Research & Related Senior/Key Person Profile Form	PM Biographical Sketch	Attach to Biographical Sketch field
	PM Current/Pending Support	Attach to Current & Pending Support field
	Key Personnel Biographical Sketch(es)	Attach to Biographical Sketch field for each senior/key person
	Key Personnel Current/Pending Support	Attach to Current & Pending Support field for each senior/key person
Attachments Form	Attachment 1 – Project Summary/Abstract	Upload as Attachment 1
	Attachment 2 – Technical Narrative	Upload as Attachment 2
	Attachment 3 – Structure and Management Plan	Upload as Attachment 3
	Attachment 4 – Colloboration and Workforce Development Plan	Upload as Attachment 4
	Attachment 5 – Quad Chart	Upload as Attachment 5
	Attachment 6 – Cost Summary Tables	Upload as Attachment 6

Table 2: Phase I Application Package Forms and Attachments.

SF 424 (R&R) Application for Federal Assistance: DTRA-specific instructions for completing the SF 424 (R&R) are below. General application instructions can be found on www.grants.gov:

- Block 1 – Type of Submission. Applicants should indicate the Phase I submission is a "Pre-Application."
- Block 2.1 – Applicant Identifier. Not applicable.
- Block 3 – Date Received by State. Not applicable.
- Block 3.1 – State Application Identifier. Not applicable.
- Block 5 – Applicant Information. You must provide a Business Office Point of Contact (BPOC) with an e-mail address.
- Block 19 – Authorized Representative. The "signature of AOR" is not an actual signature and is automatically completed upon submission of the electronic application package. Hard copies or email attachments of applications will not be accepted.

Research and Related Senior/Key Person Profile Form: The Research and Related Senior/Key Person Profile Form should be completed in its entirety for each of the individuals who will be involved in a significant way in the research and management of the Alliance, e.g., MSEE-URA PM, RALs, PIs, and Co-PIs.

DTRA does not have a preference for the format of the biographical sketch. Biographical

sketches shall be limited to three pages for the key leadership personnel, i.e., the MSEE-URA PM and the RALs. DTRA anticipates that for the MSEE-URA PM the submitted information will provide evidence of successful leadership of collaborative research.

Submission of biographical sketches for additional key personnel, e.g., PIs and Co-PIs, is required, but they must be limited to three page per individual. Applicants should take care to only submit biographical sketches for participating individuals and include subawardee PIs/Co-PIs.

Credentials, as documented on the biographical sketches, must include, among others, a record of seminal publications in the scientific literature with a citation index and a record of successful research in areas relevant to the MSEE-URA. Collectively, the biographical sketches must demonstrate how the aggregate of skills/expertise across the Alliance provides the required breadth and depth to effectively carry out the proposed program of research.

Additionally, a statement of current and pending support must be provided for each of the key personnel. This statement should include a summary of the current and pending support of related work and requires disclosure of all grants and contracts through which each MSEE-URA PM, RALs, PIs, and Co-PIs is currently receiving or may potentially receive financial support.

Attachments Form: The attachments form should be used to include the following six items with the application:

Attachment 1 – Project Summary/Abstract. The uploaded project summary should be less than three pages and provide a summary of the URA team, research program and collaboration plans. The abstract should not contain any proprietary data or markings.

Attachment 2 – Technical Narrative (limit 25 pages, including references). The technical narrative should include an overview of the research strategy to be employed to advance the state-of-the-art in MSEE; a short description and justification of the research goals for the proposed effort (for the base period and for each additional option); and a short technical discussion stating the background and objectives of the proposed research, the overall technical approaches to be pursued, the potential techniques to be used to validate the models and theories developed in this URA. This technical discussion should include a proposed breakdown of research tasks and short description of the technical approaches for each task. A discussion on the relevance of the research, strategy for validation of models, and linkages between research in the RAs and CCRI should be included. Where the technical narrative proposes research topics outside the scope described in this BAA, justification for such variance is required. The technical narrative should clearly identify specific scientific challenges and research barriers that relate to fundamental understanding of the difficulties associated with the integration of physical and social science disciplines to solve problems in MSEE. The technical narrative should clearly highlight the innovations proposed and how they may lead to substantial advances in foundational understanding of network phenomena and highlight how the proposed research is expected to feed, be fed by, or in some other way link with, research being performed elsewhere within the consortium. This only covers the core research program and its funding—no discussion of the enhanced program should be included.

Attachment 3 – Structure and Management Plan (limit 5 pages). The Structure and Management Plan must include a summary of the overall plan for leadership and management of the consortium. The pre-proposal must include the identification of the PM, LRAOs (including

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RALs), and key leadership personnel with an overall plan for leadership detailing efficient management of the MSEE -URA Program. The Structure and Management Plan should also detail subawardees. The Structure and Management Plan should demonstrate how the proposed URA will create an effective collaborative environment. The Structure and Management Plan must describe an overall strategy for adjusting the research plans in response to research insights gained, advances in the state of the art, and new collaboration opportunities.

Attachment 4 – Collaboration and Workforce Development Plan (limit 5 pages). The Collaboration and Workforce Development Plan must include general information on previous successful relevant collaborations and general plans for how researchers will collaborate within each RA and between RAs and how this collaboration will result in outcomes and further the goals of the URA. The Collaboration and Workforce Development Plan must include a summary of collaboration plans (processes and supporting toolsets), synergies gained from these collaborations, and examples of how researchers have successfully collaborated in the past and the outcomes.

Attachment 5 – Quad Chart. The quad chart must be presented on one (1) page. The quad chart must not contain any proprietary data or markings. The quad chart must be provided in landscape layout.

Attachment 6 – Cost Summary Tables. For the Phase I pre-proposal only, two cost estimate tables shall be provided to communicate a broad idea of the participant's relative level-of-effort for the core program funding only. This information will be used in the evaluation of the research program. The first table should list the estimated **first year** funding by organization for each RA (see Table 3). A column for Other can be used for management or other costs. The final line is to be used for an estimate of costs across the RAs addressing the CCRI. The second should list the estimated funding per organization for each of the five years (see Table 4).

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Organization	RA1	RA2	RA(N)	Other	Total
LRO					
LRAO-A					
LRAO-B					
LRAO-C					
LRAO-N					
Subawardees					
CCRI Portion					

Table 3: Year 1 Budget Estimates by RA/CCRI ($K).

Organization	Year 1	Year 2	Year 3	Year 4	Year 5	Total
LRO						
LRAO-A						
LRAO-B						
LRAO-C						
LRAO-N						
Subawardees						
CCRI Portion						
Total						

Table 4: Five Year Budget Estimates ($K).

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4.2.3. Phase II Proposal Submission. Each Phase II application package contains the forms detailed in Table 5.

Form	Attachment	Action
SF-424 (R&R) Application for Federal Assistance Form	N/A	Enter the appropriate information in data fields
RR Budget Form	Budget Justification for each base and option performance period	Attach to Section K "Budget Justification" in budget period one
RR Subaward Budget Attachment(s) Form	Individual subaward budgets	Attach a separate budget with justification for each subaward
Research & Related Senior/Key Person Profile Form	PI Biographical Sketch	Attach to Biographical Sketch field
	PI Current/Pending Support	Attach to Current & Pending Support field
	Key Personnel Biographical Sketch(es)	Attach to Biographical Sketch field for each senior/key person
	Key Personnel Current/Pending Support	Attach to Current & Pending Support field for each senior/key person
RR Personal Data Form	N/A	Enter the appropriate information in data fields for all PIs/Co-PIs
Research & Related Other Project Information Form	Publically Releasable Proposal Summary/Abstract	Attach to Block 7 "Project Summary/ Abstract"
	Project Narrative/Technical Proposal	Attach to Block 8 "Project Narrative"
	Bibliography	Attach to Block 9 "Bibliography"
	Facilities and Other Resources	Attach to Block 10 "Facilities and Other Resources"
	Equipment	Attach to Block 11 "Equipment"
Disclosure of Lobbying Activities (SF-LLL) *(if applicable)*	N/A	N/A
Attachments Form	Attachment 1 – Draft IPP	Upload as Attachment 1
	Attachment 2 – Structure and Management Plan	Upload as Attachment 2
	Attachment 3 – Signed AoC	Upload as Attachment 3
	Attachment 4 – Collaboration and Workforce Development Plan	Upload as Attachment 4
	Attachment 5 – Quad Chart	Upload as Attachment 5

Table 5: Phase II Package Forms and Attachments.

SF 424 (R&R) Application for Federal Assistance: DTRA-specific instructions for completing the SF 424 (R&R) are below. General application instructions can be found on www.grants.gov:

- Block 1 – Type of Submission. Applicants should indicate the Phase II submission is an "Application."
- Block 2.1 – Applicant Identifier. Not applicable.

- Block 3 – Date Received by State. Not applicable.
- Block 3.1 – State Application Identifier. Not applicable.
- Block 4b – Agency Routing Identifier. Enter the corresponding Phase I Grant ID. If resubmissions were involved, enter the Grant ID for the last submission.
- Block 5 – Applicant Information. You must provide a Business Office Point of Contact (BPOC) with an e-mail address.
- Block 19 – Authorized Representative. The "signature of AOR" is not an actual signature and is automatically completed upon submission of the electronic application package.

RR Budget Form: The Research and Related Budget Form provided as part of the application package for the Phase II submission should be filled out in its entirety for each of the first five project years. Applicants are responsible for ensuring appropriate, approved rates are used in their budget forms. When notified of selection applicants will be requested to provide their current rate agreement and the rate agreement of their subawardees, as applicable. Applicants should note that in accordance with 32 CFR 22.205(b), CAs shall not provide for the payment of fee or profit to the recipient.

Applicants are required to submit a budget justification. The budget justification should be prepared as outlined in the instructions for the Research and Related Budget and uploaded as an attachment to Section K "Budget Justification" of the Research and Related Budget Form. The budget justification does not have a page limit, but should include sufficiently detailed information for meaningful evaluation to include but not limited to the following:

- The basis for the direct labor hours or percentage of effort (e.g., historical hours or estimates);
- The basis for the direct labor rates or salaries. Labor costs should be predicted upon current labor rates or salaries. These rates may be adjusted upward for forecast salary or wage cost-of-living increases that will occur during the agreement period. The cost proposal should separately identify the rationale applied to base salary/wage for cost-of-living adjustments and merit increases. Each must be fully explained;
- The portion of time to be devoted to the proposed research, management activities, divided between academic and non-academic (summer) terms, when applicable;
- The total annual salary charged to the URA;
- Any details that may affect the salary during the project, such as plans for leave and/or remuneration while on leave.
- Amounts or percentages of cost share, expected benefits to the URA as a result, and institutional parameters for providing cost share.

In addition, the budget justification must specifically address subaward costs and type to include the portion of work to be subawarded with a supporting rationale. The budget justification should include a discussion of how the subawardee(s) cost was determined to be fair and reasonable.

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RR Subaward Budget Attachment(s) Form (if applicable): Detailed cost estimates are required for each proposed subaward (e.g., LRAOs and subawardees). The cost estimate for the subawards should include sufficiently detailed information for meaningful evaluation, including all those items listed for the LRO, as well as travel for the required meetings. However, it is recognized that some entities may choose to submit their proprietary rate information directly to the Government in lieu of providing such information to the LRO for inclusion in the cost proposal submitted through www.grants.gov. In such a case, a separate submission can be made directly to the Government via email to DTRA-URA-Program@mail.mil.

Research and Related Senior/Key Person Profile Form: The Research and Related Senior/Key Person Profile Form should be completed in its entirety for each of the individuals who will be involved in a significant way in the research and management of the Alliance, e.g., the MSEE-URA PM, RALs, PIs, Co-PIs, etc.

DTRA does not have a preference for the format of the biographical sketch. Biographical sketches shall be limited to three pages for the key leadership personnel, i.e., the MSEE-URA PM and the RALs. DTRA anticipates that for the MSEE-URA PM the submitted information will provide evidence of successful leadership of collaborative research.

Submission of biographical sketches for additional key personnel, e.g., additional PIs and Co-PIs, is required, but they must be limited to two pages per individual. Applicants should take care to only submit biographical sketches for participating individuals and include subawardee PIs/Co-PIs.

Credentials, as documented on the biographical sketches, must include, among others, a record of seminal publications in the scientific literature with a citation index and a record of successful research in areas relevant to the MSEE-URA. Collectively, the biographical sketches must demonstrate how the aggregate of skills/expertise across the Alliance provides the required breadth and depth to effectively carry out the proposed program of research.

Additionally, a statement of current and pending support must be provided for each of the key personnel. This statement should include a summary of the current and pending support of related work and requires disclosure of all grants and contracts through which each MSEE-URA PM, RALs, PIs, and Co-PIs is currently receiving or may potentially receive financial support.

RR Personal Data Form: The Government Accountability Office, in its report GAO-16-14, WOMEN IN STEM RESEARCH: Better Data and Information Sharing Could Improve Oversight of Federal Grant-making and Title IX Compliance, December 3, 2015, recommended that the DoD collect certain demographic and career information to be able to assess the success rates of women who are proposed for key roles in applications in science, technology, engineering, or mathematics disciplines. To enable this assessment, DTRA is including the OPTIONAL form titled, "Research and Related Personal Data" for proposal submissions. The Research and Related Personal Data Form provided as part of the application package for the Phase II submission should be filled out in its entirety for the PM, all PIs, and Co-PIs on the proposal.

Research and Related Other Project Information Form:

- Block 7 – Project Summary/Abstract. The uploaded project summary should be less than five pages and provide a summary of the basic research in the proposal. The abstract absolutely must not contain any proprietary data or markings.

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- Block 8 – Project Narrative (Technical Proposal). The uploaded technical proposal must not exceed 40 pages (including references).

  The project narrative (technical proposal) should include a discussion of the research strategy to be employed to advance the state-of-the-art in ADD; a detailed description and justification for ADD-year research goals of the proposed effort; and a detailed technical discussion. The technical discussion should include the background and objectives of the proposed research, the technical approaches to be pursued, the validation techniques and metrics to be used to validate the models and theories developed in this URA, and the parties involved and the level of effort to be employed (demonstrating that researchers are collaborating and substantially and meaningfully engaged in the research efforts). Where the project narrative includes research topics not listed in this BAA, a rationale must be provided. The project narrative should also clearly:

  - Identify specific scientific challenges and research barriers that relate to fundamental understanding of the root cause of difficult MSEE-related problems and should provide evidence that the proposed technical approaches can address these challenges in a measured approach across the near- and far-term.
  - Explain in substantial detail the specific scientific plans that will be employed, and provide ample evidence that the approaches are likely to substantially advance the underlying science.
  - Highlight the innovations proposed and how they may lead to an understanding of material science in extreme environments-related phenomena particularly fundamental laws, theories, and validated models.
  - Show how the proposed research is expected to feed, be fed by, or in some other way link with, research being performed elsewhere within the Alliance.

  Protection of Human Subjects. For full discussion, see Section 6.2.2. If the proposed research does involve human subjects or materials, applicants are asked to: a) justify the use of human subjects, b) outline the human use, and c) include the source of the human subjects or materials involved in the research. Applicants shall submit written evidence, to include a provisional protocol number and Institutional Review Board (IRB) point of contact information, that a human use protocol has been submitted to, and is pending approval by, a qualified IRB. Further information may be required if the proposal is successful.

  Animal Use. For full discussion, see Section 6.2.3. If the proposed research involves animal use, applicants are asked to justify the use of animals. Any proposals involving animal studies or animal work must include detailed information on the animal protocols to be used and verify the location where the studies will be conducted. Animal studies are subject to review and approval for safety and adherence to regulations. Applicants shall submit with the full proposal package written evidence, to include a provisional protocol number and Institutional Animal Care and Use Committee (IACUC) point of contact information, that a vertebrate animal use protocol has been submitted to, and is pending approval by, a qualified IACUC. Further information may be required if the proposal is successful.

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- Block 9 – Bibliography. Attach a list of the applicable references for the proposal.
- Block 10 – Facilities and Other Resources. The applicant is to include a listing of facilities and other resources available to support the proposal, including a description of the facilities to be used for the research and experiments, a description of who will have access to these facilities, and how these facilities will enhance the research efforts proposed. Where new research facilities are to be created for the purposes of the MSEE-URA, the development and verification plans are to be described.
- Block 11 – Equipment. The applicant is to include a listing of specialized equipment available to support the proposal, including a description of specialized equipment to be used for the research and experiments, a description of who will have access to the specialized equipment, and how the specialized equipment will enhance the research efforts proposed.

Disclosure of Lobbying Activities (SF-LLL) Form: The Disclosure of Lobbying Activities Standard Form-LLL, if applicable, should be completed.

Attachments Form: The attachments form should be used to include the following five items with the application:

Attachment 1 – Draft IPP. The draft IPP does not have a suggested format or a page limit. The Data Management Plan is not required as part of the draft IPP.

Attachment 2 – Structure and Management Plan. The Structure and Management Plan for the proposal shall not exceed 10 pages. The plan must include a detailed plan for leadership and efficient management of the MSEE-URA and organizational structures. The LRO, the LRAOs, subawardees, and PIs should be clearly delineated. The plan must identify metrics for success, how they will be used, and how they will further the goals of the program. Where available, evidence for the success of these strategies is to be described. The plan must describe approaches to adjusting the research plans in response to research insights gained, evolving research needs, advances in the state of the art, and new collaboration opportunities.

Attachment 3 – AoC. Applicants must submit the AoC signed by a duly authorized representative for each proposed permanent member of the Alliance. Any changes with justification should be detailed in a cover letter to the signed AoC.

Attachment 4 – Collaboration and Workforce Development Plan. The Collaboration and Workforce Development Plan for the proposal shall not exceed 10 pages. The plan must include details for how researchers will collaborate within each RA and across the RAs and describe how this collaboration will further the goals of the program. The plan must describe the processes and toolsets to facilitate collaboration and the document/information controls to be employed. The plan must describe the strategy for collaborating with DTRA and propose collaborative opportunities with DTRA PMs. The plan must include examples of how researchers have successfully collaborated previously in similar programs. The plan must address the general activities, student sandbox, staff rotations, electronic resources, etc. detailed in Section 1.5. The plan must include a strategy for identifying, establishing, and exploiting collaborations with other related research programs. The plan must describe processes for external communication of research outputs.

Attachment 5 – Quad Chart. The quad chart must be presented on one (1) page. The quad

chart must not contain any proprietary data or markings. The quad chart must be provided in landscape layout.

4.3. Unique Entity Identifier and System for Award Management (SAM)

DTRA uses the SAM to exclude recipients ineligible to receive Federal awards. SAM can be accessed online at http://sam.gov (Reference 2 CFR 1125).

Each applicant is required to: (i) Be registered in SAM before submitting its application; (ii) provide a valid unique entity identifier in its application; and (iii) continue to maintain an active SAM registration with current information at all times during which it has an active Federal award or an application or plan under consideration by a Federal awarding agency.

DTRA may not make a Federal award to an applicant until the applicant has complied with all applicable unique entity identifier and SAM requirements and, if an applicant has not fully complied with the requirements by the time DTRA is ready to make a Federal award, DTRA may determine that the applicant is not qualified to receive a Federal award and DTRA may use that determination as a basis for making a Federal award to another applicant.

4.4. Submission Dates and Times

Phase I pre-proposal submissions are due 60 days following the publishing date of the final BAA. The due date for the Phase II invited proposal submissions will be provided in the letter of invitation. The applicant will not be allowed less than 45 days to prepare a full proposal submission; there is no penalty for early submissions.

Applicants are responsible for submitting all materials to www.grants.gov. When sending electronic files, the applicant should allow for potential delays in file transfer from the originator's computer server to the www.grants.gov website/computer server, as well as the delay associated with the www.grants.gov validation of applications, which may be up to 48 hours. Applicants are encouraged to submit their proposals early to avoid issues with file transfers, rejection of applications by www.grants.gov, and delays due to high website demand.

Acceptable evidence to establish the time of receipt at the Government office includes documentary and electronic evidence of receipt maintained by DTRA. Applicants should also print, and maintain for their records, the three emails that will serve as the electronic receipt following submission of a Phase I pre-proposal or an invited Phase II proposal to www.grants.gov.

Applicants should note that DTRA uses a system that pulls applications from www.grants.gov en masse, but this system does not mark applications as "retrieved" on www.grants.gov. As a result, when applicants check the status on www.grants.gov the applications will always look like they have not been retrieved by DTRA. Should you require confirmation of receipt by the Agency, you may request such via the administrative email address provided in Section 7. Note that such requests will generally be treated with low priority by the Agency.

Please note 15 U.S.C. 260a establishes daylight saving time as the standard time during the daylight saving period.

If the application package and required attachments are submitted to www.grants.gov after the exact time and date specified in this announcement or in any written communications provided by DTRA, the application may be considered "late" and may not be reviewed.

If an emergency or unanticipated event interrupts normal Government processes so that proposals cannot be submitted to www.grants.gov by the exact time specified by DTRA correspondence, the time specified for receipt of applications will be deemed to be extended to the same time of day specified in the BAA or in the letter of invitation on the first work day on which normal Government processes resume.

4.5. Intergovernmental Review

Not Applicable.

4.6. Funding Restrictions

Applicants must be advised that DTRA will not allow reimbursement of pre-award costs.

4.7. Other Submission Requirements

4.7.1. Registration with www.grants.gov. Applicants should note that each organization must complete a one-time registration in order to submit its Phase I pre-proposal(s) and invited Phase II proposal(s) through www.grants.gov. Please see the following web link on information about registering with www.grants.gov: http://www07.grants.gov/applicants/applicants.jsp. If your organization is already registered in www.grants.gov, no further action should be required.

The registration process may take up to **four (4) weeks** to complete depending on your organization and requires multiple steps, some of which are detailed below.

- Identifying the Data Universal Number Systems (DUNS) number or registering for one with Dun & Bradstreet at http://fedgov.dnb.com/webform/displayHomePage.do if your organization does not have a DUNS number.
- Registering with the System for Award Management (SAM) by calling the SAM Assistance Center at 1-866-606-8220, or you may register online at www.sam.gov. You will NOT be able to complete your SAM registration until SAM has confirmed your Employer Identification Number (EIN) or Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS).

4.7.2. Page Definition. Documents must not exceed provided page limits. A page is defined as 8 ½ x 11 inches, single-spaced, with one-inch margins in type not smaller than 12 point Times New Roman font. All documents must be provided in portrait layout unless otherwise noted. In instances where page limits are exceeded, only the pages up to the limit will be reviewed. Exceptions WILL NOT be made under any circumstances.

4.7.3. File Format. Documents should be uploaded as a Portable Document File (PDF) format. Perform a virus check before uploading any files to www.grants.gov as part of your application package. If a virus is detected, it may cause rejection of the file.

Do not lock or encrypt any files you upload to www.grants.gov as part of your application package. Movie and sound file attachments will not be accepted.

4.7.4. Withdrawal of Submissions. Phase I pre-proposals and invited Phase II proposals may be withdrawn by written notice. Withdrawals are effective upon receipt of notice by the Grants/Contracting Officer via the e-mail address listed in Section 7.

4.7.5. English Language Requirement. All documents must be submitted in the English language. DTRA will not review any documents that are not submitted in the English language.

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Exceptions WILL NOT be made under any circumstances.

4.7.6. Incomplete Applications and Requests for Additional Information. DTRA reserves the right to consider incomplete application packages and required attachments and to request any missing information via email. Should the applicant fail to provide all the requested information either as part of the www.grants.gov submission or in response to email requests from DTRA, at their discretion, DTRA may not consider the proposal further.

4.7.7. Compliance with Appendix A to 32 CFR 28. All awards require certifications of compliance with Appendix A to 32 CFR 28 regarding lobbying. Proposers are certifying compliance with this regulation by submitting the invited proposal. It is not necessary to include the certification text with your invited proposal. If applicable, proposers should submit the Disclosure of Lobbying Activities (SF-LLL) Form in accordance with Section 4.2.3.

4.7.8. Marking Guidance and Disclosure of Proprietary Information other than to the Government. Submissions in response to this BAA may contain technical and other data that the applicant does not want disclosed to the public or used by the Government for any purpose other than application evaluation. Public release of information will be subject to existing statutory and regulatory requirements.

If proprietary information which constitutes a trade secret, proprietary commercial or financial information, confidential personal information, or data affecting national security, is provided by an applicant, it will be treated in confidence, to the extent permitted by law, provided that the following legend is included on the front page of the attachment:

> *"For any purpose other than to evaluate this submission, this data shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed in whole or in part, provided that if an award is made to the applicant as a result of or in connection with the submission of this data, the Government shall have the right to duplicate, use or disclose the data to the extent provided in the agreement. This restriction does not limit the right of the Government to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained in page(s) _____ of this document."*

Any other legend may be unacceptable to the Government and may constitute grounds for removing the submission from further consideration without assuming any liability for inadvertent disclosure.

The Government will limit dissemination of properly marked information to within official channels. In addition, the pages indicated as restricted must be marked with the following legend:

> *"Use or disclosure of the data on lines specifically identified by asterisk (*) are subject to the restriction on the front page of this document."*

The Government assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

In the event that properly marked data contained in a submission made in response to this BAA is requested pursuant to the Freedom of Information Act (FOIA), 5 U.S.C. § 552, the applicant will be advised of such request and prior to such release of information, will be requested to

expeditiously submit to DTRA a detailed listing of all information in the pre-proposal and/or invited proposal which the applicant believes to be exempt from disclosure under the Act. Such action and cooperation on the part of the applicant will ensure that any information released by DTRA pursuant to the Act is properly identified.

By submission of a Phase I pre-proposal and/or invited Phase II proposal, the applicant understands that proprietary information may be disclosed outside the Government for the sole purpose of technical evaluation. DTRA will obtain a non-disclosure agreement from the evaluator that proprietary information in the submission will only be used for evaluation purposes and will not be further disclosed or utilized.

4.7.9. Security Information. All submissions must be completely UNRESTRICTED and UNCLASSIFIED; submissions must not contain For Official Use Only (FOUO) or Official Use Only (OUO) information or be marked as such.

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5. APPLICATION REVIEW INFORMATION

5.1. Evaluation Criteria

5.1.1. Phase I Pre-Proposal Evaluation Criteria. The three evaluation criteria to be used for pre-proposal evaluations are as follows:

1. Scientific Merit and Relevance. Evaluation of this factor will concentrate on the overall scientific and technical merit, relevance to the articulated challenges, and innovation of the proposed research in light of the state-of the-art. Evaluation of this factor will also concentrate on the long term relevance of the proposed research and the likelihood this proposed research will address scientific challenges and research barriers facing DTRA.
2. Collaboration and Program Management. Evaluation of this factor will concentrate on the applicant's strategies, plans and experience in fostering collaborative research, managing collaborative research programs, and workforce development. Evaluation of this factor will be based on evidence of previous successful relevant efforts and the applicant's commitment and plans for collaboration and workforce development. Evaluation of this factor will focus on the PM's technical leadership and experience in managing large collaborative research programs and the applicant's plans to meet the requirements of the overall management concept. This factor includes plans for an environment to foster collaboration and efforts to bring about a unity of vision for the consortium and drive for results and benefits.
3. Experience and Qualifications of Scientific Staff. Evaluation of this factor will concentrate on the relevant qualifications, capabilities, availability, accomplishments, and experience of the applicant's proposed research personnel as an indication of their ability to achieve the proposed technical objectives.

5.1.2. Phase II Invited Proposal Evaluation Criteria. The five evaluation criteria to be used for Phase II invited proposal evaluations are as follows:

1. Scientific Merit and Relevance. Evaluation of this factor will concentrate on the overall scientific and technical merit, relevance to the articulated challenges, and innovation of the proposed research in light of the state-of the-art.

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2. Collaboration and Workforce Development. Evaluation of this factor will concentrate on the applicant's strategies, plans and experience in fostering collaborative research, managing collaborative research programs, and workforce development. Evaluation of this factor will be based on evidence of previous successful relevant efforts and the applicant's commitment and plans for collaboration and workforce development. This factor includes plans for an environment to foster collaboration and develop the workforce. This factor also includes efforts to bring about a unity of vision for the consortium and drive for results and benefits.

3. Experience and Qualifications of Scientific Staff and Quality of Research Facilities. Evaluation of this factor will concentrate on the relevant qualifications, capabilities, availability, accomplishments, and experience of the applicant's proposed research personnel as an indication of their ability to achieve the proposed technical objectives related to the proposed efforts. Key personnel are expected to be substantially and meaningfully engaged in the research and the proposed level of effort for key personnel should be commensurate with and demonstrate such. The extent to which the applicant's proposed facilities and equipment will contribute to the accomplishment of the proposed research will be evaluated including the nature, quality, relevance, availability, and access to state-of-the art research facilities and equipment.

4. Program Management. Evaluation of this factor will include the adequacy of the overall management plan, internal team structures, and composition with respect to achieving the research goals of the program. These approaches should be lightweight and will be evaluated for their flexibility to minimize overhead, yet ensure research relevance and proper oversight. Where available, evidence for the success of these strategies is to be described. Evaluation of this factor will include a focus on the Program Manager's technical leadership and experience in managing large collaborative research programs and the applicant's plans to meet the requirements of the overall management concept included in the BAA.

5. Cost Realism. Evaluation of this area will consider cost realism, cost reasonableness, and affordability within funding constraints. The Government may make adjustments to the cost of the total proposed effort as deemed necessary to reflect what the effort should cost. These adjustments will consider the task undertaken and approach proposed. These adjustments may include upward or downward adjustments to proposed labor hours, labor rates, quantity of materials, price of materials, overhead rates, general and administrative expenses (G&A), etc.

5.2. Review and Selection Process

The Phase I pre-proposal and invited Phase II proposal selection process will be conducted based upon a technical review as described in the DoDGARs (32 CFR 22.315(c)) and includes the use of non-Government peer-reviewers. Phase I pre-proposals are expected to be evaluated by a group of qualified scientists and managers from the Government. However, the Government reserves the right to have Phase I pre-proposals evaluated by subject matter experts outside the Government. Invited Phase II proposals will be evaluated by a group of qualified scientists and managers from the Government as well as subject matter experts from outside the Government. In all instances when non-Government evaluators will be used, they will be required to sign a non-disclosure statement before being provided access to Phase I pre-proposals and invited

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Phase II proposals. Additional information is included in Section 8.1.

The Phase I pre-proposal evaluation will be based on three criteria listed in decreasing order of importance: 1) Scientific Merit and Relevance, 2) Collaboration and Program Management, and 3) Experience and Qualifications of Scientific Staff. The criteria will be scored as Outstanding (O), Good (G), Acceptable (A), Marginal (M) or Unacceptable (U). Phase I pre-proposals scored as "Unacceptable" in any single category will be deemed "Not Selectable" and will not be considered further.

The invited Phase II proposal evaluation will be based on five criteria; however, only criteria one to four are weighted. They are listed in decreasing order of importance: 1) Scientific Merit and Relevance, 2) Collaboration and Workforce Development, and 3) Experience and Qualifications of Scientific Staff and Quality of Research Facilities, and 4) Program Management. These criteria will be scored as Outstanding (O), Good (G), Acceptable (A), Marginal (M) or Unacceptable (U). The fifth criterion of Cost Realism will be scored as Acceptable (A) or Unacceptable (U). Invited Phase II proposal scored as "Unacceptable" in any single category will be deemed "Not Selectable" and will not be considered further.

Only the most highly rated Phase I pre-proposals will receive an invitation to submit a Phase II proposal. Only those receiving an invitation can expect feedback. Applicants that do NOT receive an invitation from the Government to submit a Phase II proposal are NOT eligible to submit a Phase II proposal. Applicants not receiving an invitation to submit Phase II proposals will be informed of such via email following the Phase I pre-proposal evaluations.

Prior to award, the Government reserves the right to perform a review of past performance. Sources that may be used for past performance review may include the Past Performance Information Retrieval System (PPIRS) and the Federal Awardee Performance and Integrity Information System (FAPIIS). The Government will also evaluate the impact of any proposed limitations to the use of intellectual property (e.g. asserted technical data/computer software restrictions or patents) during the selection and/or negotiation process, and may request additional information from the applicant, as may be necessary, to evaluate the applicant's assertions.

The potential relationship of the proposed research and development to the DTRA mission will be considered during the selection process. Other factors that may be considered include duplication with other research, program balance across research topics, and budget limitations. Accordingly, proposals may be selected for funding which are not reviewed as highly as others, which are of higher risk and/or which may be of a higher cost.

The Government will not review any submission that is not relevant to this BAA or Phase II proposals that were not invited. The Government reserves the right to select all, some, or none of the proposals, or any part of any proposal received in response to this BAA and to make awards without discussions with applicants; however, the Government reserves the right to conduct discussions if determined necessary.

5.3. Simplified Acquisition Threshold

DTRA anticipates that the total Federal share of awards made under this announcement will be greater than the simplified acquisition threshold over the period of performance (see §200.88 Simplified Acquisition Threshold). Therefore, in accordance with Appendix I to 2 CFR Part 200, Section E.3, this section serves to inform the applicant:

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i. That DTRA, prior to making a Federal award with a total amount of Federal share greater than the simplified acquisition threshold, is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (currently Federal Awardee Performance and Integrity Information System (FAPIIS)) (see 41 U.S.C. 2313);

ii. That an applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a Federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM;

iii. That DTRA will consider any comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under Federal awards when completing the review of risk posed by applicants as described in §200.205 Federal awarding agency review of risk posed by applicants.

iv. For awards that exceed $500,000 over the period of performance, DTRA will employ the additional post-award reporting requirements reflected in Appendix XII—Award Term and Condition for Recipient Integrity and Performance Matters of 2 CFR 200.

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6. AWARD ADMINISTRATION INFORMATION

6.1. Award Notices

Applicants will be notified regarding the status of their applications via e-mail to the BPOC listed in Block 5 of the SF-424 and the PI listed in Block 14 of the SF-424 provided at the time of submission.

A notice of selection should not be construed as an obligation on the part of the Government; only duly authorized procurement personnel may commit resources. This will be done by issuing a CA document to the selected applicant. Also, this notification must not be used as a basis for accruing costs to the Government prior to award. Selected applicants are not authorized to begin work, as any award is subject to successful negotiations (if determined necessary by DTRA) between the DTRA contracting division and the selected organization, and to the availability of funds.

All notifications will be made from DTRA-URA-Program@mail.mil.

Applicants must be aware that it is their responsibility to ensure: (1) correct e-mail addresses are provided at the time of submission, (2) this e-mail notification reaches the intended recipient(s), and (3) the e-mail is not blocked by the use of ‘spam blocker’ software or other means that the recipient’s Internet Service Provider may have implemented as a means to block the receipt of certain e-mail messages.

If for any reason there is a delivery failure of these e-mail notices, DTRA will not further attempt to contact the applicants.

6.2. Administrative and National Policy Requirements

Awards from this BAA will be governed by the DoD Research and Development General Terms

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and Conditions, the most current version as of the date of the award (available for download at website http://www.onr.navy.mil/Contracts-Grants/submit-proposal/grants-proposal/grants-terms-conditions.aspx). DTRA-specific Terms and Conditions governing intellectual property, required reporting, payment information, etc. will be provided at the time of award negotiations. All awards require certifications of compliance with national policy requirements. Statutes and Government-wide regulations require some certifications to be submitted at the time of proposal submission.

This BAA focuses on fundamental research in a DoD contractual context, which was defined in Section 1.2 of this BAA. Per the Under Secretary of Defense for Acquisition, Technology and Logistics Memorandum, SUBJECT: Contracted Fundamental Research, dated 26 Jun 2008, "…products of fundamental research are to remain unrestricted to the maximum extent possible." Furthermore, "The DoD will place no other restrictions on the conduct or reporting of unclassified fundamental research, except as otherwise required by statue [sic], regulation, or Executive Order." As such, fundamental research is normally exempt from controls under the International Traffic in Arms Regulation (ITAR) (22 CFR Parts 120-130) and/or the Department of Commerce regarding the Export Administration Regulations (15 CFR Parts 730-774), but the DoD rule recognizes that there are "rare" situations where export-controlled information or technology may be used in fundamental research that may require a license(s) or restrictions on products.

6.2.1. Export Control Notification. Applicants are responsible for ensuring compliance with any export control laws and regulations that may be applicable to the export of and foreign access to their proposed research. Applicants may consult with the Department of State with any questions regarding the International Traffic in Arms Regulation (ITAR) (22 CFR Parts 120-130) and/or the Department of Commerce regarding the Export Administration Regulations (15 CFR Parts 730-774). Please note that the prime awardee is responsible for monitoring ITAR compliance of all subawardees.

6.2.2. Protection of Human Subjects. If the proposed research involves human subjects or materials, applicants are asked to: a) justify the use of human subjects, b) outline the human use, and c) include the source of the human subjects or materials involved in the research. As a condition precedent to receipt of DTRA funding, applicants must ensure that the basic rights and welfare of human subjects are protected. Applicants shall submit with the full proposal package written evidence, to include a provisional protocol number and Institutional Review Board (IRB) point of contact information, that a human use protocol has been submitted to, and is pending approval by, a qualified IRB. Further information may be required if the proposal is successful.

All research under any award made under this BAA involving human subjects must be conducted in accordance with 32 CFR 219, 10 U.S.C. § 980, and DoD Instruction 3216.02, and, as applicable, 21 CFR parts 11, 50, 56, Good Clinical Practice, the ICH, as well as other applicable federal and state regulations. Awardees must be cognizant of and abide by the additional restrictions and limitations imposed on the DoD regarding research involving human subjects, specifically as regards vulnerable populations (32 CFR 219 modifications to subparts B-D of 45 CFR 46), recruitment of military research subjects (32 CFR 219), and surrogate consent (10 U.S.C. § 980).

DTRA Directive 3216.01 of June 9, 2010, modified March 18, 2015, established the DTRA Human Subjects Protection Program, set forth the policies, defined the applicable terms, and

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delineated the procedures necessary to ensure DTRA compliance with federal and DoD regulations and legislation governing human subject research. The regulations mandate that all DoD activities, components, and agencies protect the rights and welfare of human subjects of study in DoD supported research, development, test and evaluation, and related activities hereafter referred to as "research." The requirement to comply with the regulations applies to new starts and to continuing research.

The DTRA Directive requires that research using human subjects may not begin or continue until the DTRA Research Oversight Board (ROB) has reviewed and approved the proposed protocol. Contractors and subcontractors are required to submit a valid federal assurance for their organization (institution, laboratory, facility) that has been issued by either DoD or the Department of Health and Human Services, and documentation of review of proposed protocols by the local IRB to include consent forms for any planned research using human subjects to the DTRA ROB for its review through the contracting officer's representative (if assigned) or the contracting officer. The ROB review is separate from, and in addition to, local IRB review.

A study is considered to involve human research subjects if: 1) there is interaction with the subject (even simply talking to the subject qualifies; no needles are required); and 2) if the study involves collection and/or analysis of personal/private information about an individual, or if material used in the study contains links to such information.

Written approval to begin research or to subcontract for the use of human subjects under the proposed protocol will be provided in writing from the DTRA ROB, through the contracting officer. Both the contractor and the Government must maintain a copy of this approval. Any proposed modifications or amendments to the approved protocol or consent forms must be submitted to the local IRB and the DTRA ROB for review and approval. Examples of modifications/amendments to the protocol include, but are not limited to:

- a change of the Principal Investigator;
- changes in duration or intensity of exposure to some stimulus or agent;
- changes in the information requested of volunteers, or changes to the use of specimens or data collected; or
- changes in perceived or measured risks or benefits to volunteers that require changes to the study.

Research pursuant to such modifications or amendments must not be initiated without IRB and ROB approval except when necessary to eliminate apparent and immediate hazards to the subject(s).

Research projects lasting more than one year require IRB review at least annually, or more frequently as required by the responsible IRB. The contractor or subcontractor must provide documentation of continued IRB review of protocols for ROB review and approval in accordance with the Contract Data Requirements List. Research changes must be reviewed by the IRB and ROB in advance unless necessary to eliminate apparent and immediate hazards to the subject(s).

A clause regarding human subjects research will be included in all contracts involving human subjects research. Non-compliance with any provision of this clause may result in withholding of payments under the contract pursuant to the contract's payments clause(s) and/or contract

termination pursuant to the contract's termination clause(s). The Government shall not be responsible for any costs incurred for research involving human subjects prior to protocol approval by the ROB.

6.2.3. Animal Use. If the proposed research involves the use of live nonhuman vertebrate animals, applicants are required to justify the use of animals by providing detailed information on the proposed animal use, to include the proposed species and number of animals planned, along with the location(s) where the animal study(ies) is planned. Additional information will be required if the proposal is selected for award subject to successful negotiations. The Animal Care and Use Review Office (ACURO), a component of the USAMRMC Office of Research Protections (ORP), must review and approve all animal use prior to the start of working with animals. Therefore, Principle Investigators will be required to complete and submit the animal use appendix titled "Research Involving Animals", after award of the procurement instrument, which is available on the ACURO website (http://mrmc.amedd.army.mil/index.cfm?pageid=research_protections.acuro). Allow 2 to 4 months for regulatory review and approval processes for animal studies. Applicants are to build this review time into their project schedules.

DoD Instruction 3216.01, dated September 13, 2010, provides policy and requirements for the use of animals in DoD-funded research based on Army Regulation (AR) 40-33. The DoD definition of animal is any live nonhuman vertebrate. All proposals that involve the use of animals must be in compliance with DoD Instruction 3216.01 and AR 40-33. DTRA requires that research using animals not begin or continue until the ACURO has reviewed and approved the proposed animal use. For animals, the provisions include rules on animal acquisition, transport, care, handling, and use in: (i) 9 CFR parts 1-4, Department of Agriculture rules that implement the Laboratory Animal Welfare Action of 1966 (U.S.C. 2131-2156); and (ii) the "Guide for the Care and Use of Laboratory Animals," National Institutes of Health Publication No. 86-23.

6.2.4. Biological Defense Research Program (BDRP) Requirements: BioSurety and Select Agent Use.

Proposals must specify what Select Agent work will be conducted at the applicant's facility and what Select Agent work will be performed in other facilities. Proposals also must provide the source of the Select Agent(s), any appropriate registration information for the facilities, and specify the Laboratory Bio-safety Level. All Select Agent work is subject to verification of information and certifications. Further information may be required if the proposal is successful.

For those institutions in which PI's are conducting research with Bio-safety Levels 3 and 4 material, a Facility Safety Plan must be prepared and made available during the project award phase in accordance with 32 CFR 626.18.

For projects that will employ the use of chemical agents, either neat agent or dilute agent, the offeror must provide approved Facility Standard Operating Procedures that conform to Federal, State and local regulations and address the storage, use and disposition of these chemical materials.

6.2.5. Dual-Use Potential. In accordance with National Science Advisory Board for Biosecurity (NSABB) recommendations, DTRA will not support research that, based on current understanding, can reasonably be anticipated to provide knowledge, information, products, or

technologies that could be directly misapplied to pose a significant threat with broad potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, materiel, or national security. Research involving select agents and toxins is within scope of the DTRA mission; however, the use of select agents and toxins in certain experimental categories is considered "dual-use research of concern" (DURC) according to U.S. policy. (http://www.phe.gov/s3/dualuse/Documents/us-policy-durc-032812.pdf) Proposals that contain DURC will not be funded. Dual-use potential will be assessed based on application of the following criteria:

- Use of select agents or toxins. This factor evaluates whether the proposed research involves use of one or more select agents or toxins [as identified by the Select Agent Program under Federal Law (7 C.F.R. part 331, 9 C.F.R. part 121, and 42 C.F.R. part 73)] which pose significant risk of deliberate misuse with potential for mass casualties or devastating effects to the economy, critical infrastructure, or public confidence.
- Scope of proposed experiments. This factor evaluates whether the proposed research involves experiments that will produce, aim to produce, or is reasonably anticipated to produce: (a) Enhanced harmful consequences of the agent or toxin; (b) Disruption of immunity or effectiveness of an immunization against the agent or toxin without clinical or agricultural justification; (c) Conferred resistance by the agent or toxin to clinically or agriculturally useful prophylactic or therapeutic interventions against the agent or toxin, or facilitated ability to evade detection methodologies; (d) Increased stability, transmissibility, or dissemination ability of the agent or toxin; (e) Altered host range or tropism of the agent or toxin; (f) Enhanced susceptibility of a host population to the agent or toxin; or (g) Eradicated or extinct select agents or toxins.

6.2.6. Combating Trafficking in Persons. The recipient agrees to comply with the trafficking in persons requirement in Section 106(g) of the Trafficking Victims Protection Act of 2000 (TVPA), as amended (22 U.S.C. 7104(g)).

6.2.7. Reporting Subawards and Executive Compensation. The recipient agrees to ensure they have the necessary processes and systems in place to comply with the reporting requirements of the Transparency Act, as defined at 2 CFR 170.320, unless they meet the exception under 2 CFR 170.110(b).

6.2.8. Representation Regarding the Prohibition on Using Funds under Grants and Cooperative Agreements with Entities that Require Certain Internal Confidentiality Agreements. By submission of its proposal or application, the applicant represents that it does not require any of its employees, contractors, or subrecipients seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting those employees, contractors, or subrecipients from lawfully reporting that waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information. Note that: (1) the basis for this representation is a prohibition in section 743 of the Financial Services and General Government Appropriations Act, 2015 (Division E of the Consolidated and Further Continuing Appropriations Act, 2015, Pub. L. 113-235) and any successor provision of law on making funds available through grants and cooperative agreements to entities with certain internal confidentiality agreements or statements; and (2) section 743 states that it does not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency

governing the nondisclosure of classified information.

6.3. Reporting

General requirements are provided below; however, each awardee should check the award agreement and/or terms and conditions to determine the requirements for that specific award.

6.3.1. Quarterly Technical Reports. Quarterly roll up of technical accomplishments/data, including a listing of patents, publications, and presentations. The quarterly report should also include a listing of projects that have started/ended, financial metrics, and a staffing update of current efforts under the award.

6.3.2. Annual Reports. Annual Reports are due annually on the anniversary of the award. The Annual Report is *not* a cumulative report.

6.3.3. Final Technical Reports. A comprehensive final technical report is required prior to the end of the base period (i.e., Volume I). Comprehensive technical reports are also due at the end of any option periods that cover only the work performed during the option period (i.e., Volume II and Volume III). Collectively, these reports will provide end-to-end documentation of all the work accomplished under the award.

The final report will always be sent to the Defense Technical Information Center (DTIC) and reports may be available to the public through the National Technical Information Service (NTIS).

6.3.4. Financial Reports. Federal Financial Reports (SF-425) are due no later than 1 July of each year. Awards effective after 31 January will not require a Federal Financial Report until 1 July of the following year.

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7. AGENCY CONTACTS

Questions regarding the content of this BAA must be addressed to the following email address: DTRA-URA-Program@mail.mil.

DTRA will not release employee personal contact information.

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8. OTHER INFORMATION

8.1. Technical and Administrative Support by Non-Government Personnel

It is the intent of DTRA to use both Government and non-Government personnel to assist with the review and administration of submittals for this BAA. All Phase I pre-proposals and invited Phase II proposals may be reviewed by subject matter experts, including, but not limited to, peer reviewers from across the academic and industrial community, as applicable to the proposed research.

Further, participation in this BAA requires DTRA support contractors to have access to Phase I pre-proposal and invited Phase II proposal information including information that may be considered proprietary or otherwise marked with restrictive legends. Existing DTRA contractors include but may not be limited to the following: Cherokee Nation Strategic Programs, LLC

(contract specialist support); Kent, Campa and Kate, Inc. (contract closeout support); SAIC (advisory and assistance services); Quanterion Solutions, Inc. (DTRIAC); Kforce Government Solutions, Inc. (financial/accounting support); and CACI (contract writing system administration). Each contract contains organizational conflict of interest provisions and/or includes contractual requirements for non-disclosure of proprietary contractor information or data/software marked with restrictive legends. The applicant, by submitting a Phase I pre-proposal and invited Phase II proposal, is deemed to have consented to the disclosure of its information to the aforementioned contractors under the conditions and limitations described herein.

All individuals—including subject matter experts and support contractors—having access to any proprietary data must certify that they will not disclose any information pertaining to this BAA including any submittal, the identity of any submitters, or any other information relevant to this BAA. All applicants to this BAA consent to the disclosure of their information under these conditions.

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