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I. OVERVIEW OF THE FUNDING OPPORTUNITY

A. REQUIRED OVERVIEW CONTENT

1. **Federal Agency Name:** U.S. Army Research Laboratory (ARL), 2800 Powder Mill Road, Adelphi, MD 20783-1197

2. **Issuing Acquisition Office:** U.S. Army Contracting Command – Aberdeen Proving Ground (Soldier, Chemical, Research & Test), RTP Contracting Division, 4300 S. Miami Blvd., Durham, NC 27703

3. **Funding Opportunity Title:** MultiScale multidisciplinary Modeling of Electronic materials (MSME) Collaborative Research Alliance (CRA)

4. **Announcement Type:** Initial

5. **Funding Opportunity Number:** W911NF-11-R-0002

6. **Catalog of Federal Domestic Assistance (CFDA) Number(s):** 12.630 - "Basic, Applied, and Advanced Research in Science and Engineering"

7. **Dates:** The following is a summary of the events and dates associated with the MSME CRA Program Announcement (PA):

EVENT	ESTIMATED DATE/TIMEFRAME
Draft PA released	27 October 2010
Opportunity Conference	19 November 2010
Open House	9 December 2010
Final PA released	21 January 2011
Proposals due	7 March 2011
Evaluation and Negotiations	June-August 2011
Final Proposals due	August 2011
Award made	February 2012

B. EXECUTIVE SUMMARY

The purpose of this United States Army Research Laboratory (ARL) **MultiScale multidisciplinary Modeling of Electronic materials (MSME) Collaborative Research Alliance (CRA) Program Announcement (PA)** is to solicit offers that will help fulfill the research and development goals of the U.S. Department of the Army. The Army envisions the Alliance will bring together government, industrial, and academic institutions to undertake the fundamental research necessary to enable the quantitative understanding of electronic materials from the smallest to the largest relevant scales. Resulting models are needed to create new understanding and improved electronic device applications to include sensors and electronics for enhanced battlespace effects, and efficient power and energy devices.

The objective of this Alliance is to conduct fundamental research to create MSME to support development of future electronic materials and devices for the Army. To achieve this, the Alliance is expected to advance the fundamental science, understanding and state-of-the-art (SoA) for Multiscale Multidisciplinary Models in each of the following Electronic Materials Research Areas: 1) Electrochemical Energy Devices, 2) Hybrid Photonic, Spintronic Devices, and 3) Heterogeneous Metamorphic Electronics. The intent is for the Multiscale Models to be developed by the MSME Team. The experimentation for validation and verification for these models will be performed by ARL scientists in each of the three Electronic Materials Research Areas, which is expected to be part of a continual process to improve and create new models through collaboration between ARL and the MSME Team.

Programmatically, the CRA should initiate and execute a fundamental, cohesive, multidisciplinary collaborative research program that links MSME across length and time scales with validated modeling. Responses to the PA are expected to provide a plan to perform materials by design by addressing the following Multiscale Modeling Research Core Elements for each of the Electronic Materials Research Areas above: 1) Modeling and Simulation, 2) Bridging the Scales, 3) Multiscale Modeling Metrics, 4) Validation and Verification, and 5) Processing and Synthesis. Innovative crosscutting themes across both the Electronic Materials Research Areas and Multiscale Modeling Research Core Elements are envisioned to advance the SoA as part of this initiative.

To accomplish the objectives of this CRA, the Army envisions the PA will establish an environment for the Alliance to advance technology by conducting a number of individual, coordinated and collaborative research tasks based upon a series of consistent, yet flexible annual research plans that will be highly responsive to the needs of the Army and Department of Defense (DoD). These plans will include the interchange of scientists and engineers from among the Alliance participants, as well as educational opportunities that will serve to strengthen the ability of the Alliance and the larger research community to create new understanding and improved electronic device applications to include sensors and electronics for enhanced battlespace effects and efficient power and energy devices.

A successful fundamental research program under the MSME CRA will achieve the following scientific goals, with tangible benefits to the soldier at each stage: (NOTE: These goals are described in greater detail in the FUNDING OPPORTUNITY DESCRIPTION below.)

2-Year Goals:

Science: Advance the fundamental understanding and implementation of Physics-Based Modeling of Electronic Materials across both time and space to develop a set of algorithms/theories for a broad range of electronic materials to create new and/or improved electronic devices, and advance the understanding of existing performance.

Benefit to the Soldier: Resulting models and algorithms will enable the advancement of sensors and power and energy devices on the battlefield.

5-Year Goals:

Science: Integrate new multidisciplinary /multiscale physics to enable multiscale modeling and simulation capability that is validated experimentally in time and space to apriori design new or improved electronic materials that are uniquely characterized, synthesized and processed.

Benefit to the Soldier: Resulting models and algorithms will enable the development of new sensors and power and energy devices on the battlefield. The CRA will transition to ARL the key materials characteristics and properties to achieve power and energy devices with twice the energy density and 10-15% more lifetime; and sensors that are 10-15% more efficient.

10-Year Goals:

Science: Advance the state of the art in multiscale modeling and electronic materials to create a capability for "Materials Optimization and Materials by Design".

Benefit to the Soldier: The CRA and ARL will exercise "Materials by Design" capability to design new sensors and power and energy devices for the battlefield that have treble the energy density, 30% longer lifetimes, and are 20-30% more efficient at a lower cost.

Award Instrument: This PA will result in the award of one Cooperative Agreement (CA) as defined at 31 U.S.C. 6305 for execution of the program. The CA will be awarded to a Recipient that must be an academic institution. For purposes of this PA, the Recipient will be known hereafter as the Lead Research Organization (LRO) to reflect the fact that the LRO will be responsible for spearheading the focused basic research program. It is expected that the LRO could be augmented with up to two Key Subawardees, however offerors may elect to deviate from this limit provided adequate rationale is included in the proposal. Key Subawardees will be known hereinafter as "Partners", to distinguish their degree of participation in execution of the program as compared to other subawardees. Subawardees, be they Key or other, may be academic, industrial or non-profit concerns. Together, the LRO, Key Subawardees and subawardees will form the MSME Team.

Additionally, it is required that "covered educational institutions" (to include Historically Black Colleges and Universities and Minority-Serving Institutions or HBCU/MSIs – see also **PART II.C.1** below) receive 5-10% of the annual funding under the cooperative agreement. Finally, since fundamental research in any aspect of material science draws upon a broad palette of science and engineering, it is expected that performance will be enhanced by a constantly changing group of additional researchers and research organizations (subawardees) chosen jointly by the LRO, Partners and the Government to foster new ideas, innovation and thus complement research already undertaken by the MSME Team and the Government. To insure these new ideas and innovations are a core element of the CA at least five percent (5%) of the annual research effort is expected to be devoted to novel and innovative research conducted by these subawardees. The Alliance will also be able to seek opportunities for basic and applied research from other government agencies that enhance and or parallel the core basic research program of the CRA.

Period of Performance: The award made as a result of this PA will provide for a period of performance of five years, with an optional five-year extension period.

Place of Performance: There will be no limitation to the place of performance for any organization participating under the CA.

Funding: This PA is issued subject to the availability of funds. ARL has submitted the requisite documents to request funding for the period covered by the CA; however, offerors are reminded that this request is subject to Presidential, Congressional and Departmental approval. **The funding levels provided in the PA are for proposal preparation purposes only. The actual funding level of the CA will be updated annually as a result of the appropriation process.** The PA provides the estimated funding levels for the Core Research Program for the MSME CRA. Further, this PA identifies additional levels of funding to potentially enhance the research program with additional basic and applied research funds. It is expected that during performance there will be opportunities to secure this additional funding from ARL or other Government agencies to be added to the CA to enhance the core basic research program. This "Enhanced Research Program" funding is not currently available or in the financial plans for ARL.

Profit/Fee: Profit/fee is not permitted under the CA.

Cost Sharing: Except for a Federally-Funded Research and Development Center (FFRDC) or a National Lab, cost sharing is not required to be responsive to the PA. However, cost sharing is encouraged. During the evaluation of proposals, cost sharing will be evaluated as it relates to the evaluation factors listed in the PA, based on the degree to which the proposed cost sharing enhances the proposal to result in added benefits to the MSME CRA Program. In order for the proposed cost sharing to receive appropriate credit during the evaluation process, the proposal should evidence a firm commitment to provide such cost share and also evidence **a process for integrating the cost share into the collaborative research program.**

Proposal Submission: **PART II.D** of the PA provides information on proposal preparation and submission. Offerors should note that there are page limitations and other requirements associated with the submission process. Proposals in connection with this PA are due by the date and time specified in **PART II.D**.

Evaluation and Award: Evaluation and Award in connection with this PA will be performed in accordance with **PART II.E.**

Questions & Comments: All questions or comments concerning this PA will be posted through the MSME CRA website at www.arl.army.mil/CRAMSME. Questions and comments should be concise and to the point. In addition, the relevant part and paragraph of the PA should be referenced. Responses to questions received will be posted to the MSME CRA website for the benefit of all interested parties. Should an offeror have questions they believe are of a proprietary nature, the offeror must clearly state so in the question when posed. Answers to questions of a proprietary nature will be provided via email directly to the poser of the question.

Opportunity Conference: An Opportunity Conference concerning the MSME CRA was held on 19 November 2010. The purpose of the Opportunity Conference was to provide potential offerors with information concerning the MSME CRA and to provide an opportunity for potential offerors to discuss the MSME CRA with Government personnel. All presentations, questions, and answers discussed at the Opportunity Conference have been posted on the MSME CRA website. While offerors were encouraged to attend the Opportunity Conference, offerors may submit proposals under this PA without attending the Opportunity Conference. (NOTE: The Opportunity Conference covered both the MSME CRA and another CRA being issued by ARL associated with Materials in Extreme Dynamic Environments (MEDE). See www.arl.army.mil/CRAMEDE for additional information on the MEDE CRA.)

Open House: ARL's Open House for the MSME CRA was held on 9 December 2010. The purpose of the Open House was to provide potential offerors with information on ARL's internal mission program, capabilities and facilities for planning their proposed collaborative efforts with ARL employees in response to the MSME CRA PA. While offerors were encouraged to attend the Open House, offerors may submit proposals under this PA without attending the Open House.

II. DETAILED INFORMATION ABOUT THE FUNDING OPPORTUNITY

A. FUNDING OPPORTUNITY DESCRIPTION

1. ARL Vision

Today, the performance and effectiveness of many advanced Army materials are fundamentally influenced by finite scale effects. Whether a technology can suit the needs of the warfighter – by lightening the load, extracting selected information from the electromagnetic environment, or enabling greater lethality, survivability, or sustainability – may ultimately be decided by material constraints due to physical mechanisms at nanometer scales. Thus accurate understanding, influence, and eventual control over those mechanisms, in the broad contexts of synthesis, manufacturing, engineering, and operation of the system to which the materials belong, are the key outcomes sought over a long term. Such capabilities would enable both the discovery of new materials as well as the optimization of existing materials. Universally, however, are features such as defects, surfaces and interfaces, which can profoundly affect physical, chemical, electrical, optical, and mechanical behavior. Study of such material features is a pervasive theme in the global research community but their exploitation to enable control over behavior is the focus of the Army's larger vision. Rigorous multiscale relationships – articulated through theory, validated by laboratory measurement, simulated via models – are therefore inherent to any approach. Research must plan accordingly to understand how to traverse length and time scales, and also how to exercise that understanding towards material control. The associated underpinning science has the potential to improve the Army's capabilities in a transformative sense by categorically increasing functionality and mobility while simultaneously reducing vulnerability and power consumption.

The Army seeks a sustained research program, comprised jointly of extramural and intramural basic research efforts, which through collaborative research will methodically and systematically push towards this vision. To this end, the Army Research Laboratory will establish the Enterprise for Multiscale Research of Materials with three components: 1) a CRA for Materials in Extreme Dynamic Environments (MEDE), 2) CRA for MultiScale multidisciplinary Modeling of Electronic materials (MSME) and 3) an in-house Initiative for Multiscale Modeling of Materials (I3M).

As part of both CRAs, ARL Scientists will have substantial involvement in performance, with a cadre of ARL scientists engaged in deep and meaningful collaborative research with the other CRA team members. The MEDE CRA will develop the capability to design, create, synthesize, process and manufacture high strain rate tolerant materials and material systems. The MEDE CRA may consider a range of material classes such as metals, ceramics, polymers and composites. The MSME CRA will develop the capability, with modeling emphasis, to create electronic device applications to include sensors and electronics for enhanced battlespace effects and efficient power and energy devices. The MSME CRA will focus on advancing the fundamental science, understanding, and state-of-the-art (SoA) for Multiscale Multidisciplinary Models in each of the following Electronic Materials Research Areas: 1) Electrochemical Energy Devices, 2) Hybrid Photonic, Spintronic Devices, and 3) Heterogeneous Metamorphic Electronics.

As part of ARL's vision for an Enterprise for Multiscale Research of Materials, the MSME and MEDE Alliances will work collaboratively with the I3M to identify areas for interdependent basic research projects that have definitive links to the current Army mission and long-term vision. Collaborations or transition links among the CRAs and I3M will also be pursued and defined through continuous collaboration, technical exchanges, site visits, staff rotations, and mutual participation in technical reviews during the period of performance. This will strengthen Army/ARL mission-relevance in the CRA research and enable the transition of developments from the Enterprise to

further strengthen ARL's efforts in multiscale multidisciplinary computational science, polymer & soft matter science, and optoelectronic/electronic/power & energy science. Within these contexts, and through collaborations via the CRA, the outcomes will take the form of theoretical, modeling or experimental methods that improve mission flexibility and capabilities for ARL to pursue its core mission programs and business areas with the visionary arc towards materials by design.

Details of the Mission Programs relevant to this CRA are in **Section II.A.2**. Contingent on the availability of funds, the program will also increasingly seek staff and subject matter expertise from the CRA to join the laboratory as jointly-advised students, post-doctoral associates and ultimately as candidates for permanent career civilian positions. These "personnel transitions" will expedite technical transitions while improving researcher collaborations.

2. ARL Sensors and Electron Devices Directorate (SEDD) Internal Mission Program

Since the SEDD Internal Mission Program will be a core element that defines the collaboration between ARL and the CRA and to provide a background for the relevance of the research to be funded under the CRA a description of the mission program follows. Offerors may also consult the ARL Web Site at: http://www.arl.army.mil/www/default.cfm.

The U.S. Army Research Laboratory's Sensors and Electron Devices Directorate (SEDD) is the principal Army organization for basic and applied research in sensors, electron devices, and power and energy to ensure U.S. military superiority. SEDD conducts innovative research in the areas of sensors, electron devices and power and energy to provide the Army with affordable enabling technology in advanced electro-optical technologies; flexible displays; advanced RF technologies; electronic materials and devices; autonomous sensing; micro autonomous technologies; hybrid electric vehicle, platform, and pulse power; directed energy; and micro, Soldier, and portable power. SEDD coordinates these technologies within ARL and the Army, with other services and agencies, and with industry and academia, to leverage basic and applied research opportunities for the benefit of the Army. Major research areas in sensors include advanced electro-optical technologies; flexible displays; advanced RF technologies; electronic materials and devices; autonomous sensing; and micro autonomous systems and technology. Additionally, major research areas in power and energy include Hybrid Electric Vehicle (HEV), platform and pulse power; directed energy; and micro, Soldier, and portable power. More information can be found at http://www.arl.army.mil/www/default.cfm?page=32.

This PA is for the creation of a new CRA to advance the state of the art in materials science specifically in the area of "MultiScale multidisciplinary Modeling of Electronic materials." The strategic direction of this CRA is to develop these multiscale models for quantitative understanding of materials from the smallest to the largest relevant scales to create new and improved electronic device applications to include sensors for enhanced battlespace effects, sensing and processing, and efficient power and energy.

To achieve this objective, the Alliance will advance fundamental science and technology in the three Electronic Materials Research Areas significant to ARL SEDD mission programs, which include 1) Electrochemical Energy Devices; 2) Hybrid Photonic, Spintronic Devices; 3) Heterogeneous Metamorphic Electronics. However, offerors are welcome to propose other areas for multiscale modeling that fall within one of the three materials research areas outlined below.

3. CRA Programmatic Strategy

The programmatic and research strategy outlined below provides the structure for the desired comprehensive and cohesive outcome of the CRA. The core basic research program will be funded under Budget Activity 1 (6.1 basic research) as defined and discussed below. However, the CRA will also allow participation from other government agencies (see discussion of Enhanced Program below) which may result in additional 6.1 (basic research) funding as well as Budget Activity 2 (6.2 applied research) funding. The research proposed and performed must comply with the definition for Budget Activity 1 or 2 funding (as appropriate) as outlined in the DoD Financial Management Regulation (FMR), Volume 2B, Chapter 5 (July 2008) as follows:

Budget Activity 1, Basic Research. Basic research is systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. It includes all scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. It is farsighted high payoff research that provides the basis for technological progress. Basic research may lead to: (a) subsequent applied research and advanced technology developments in Defense-related technologies, and (b) new and improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures, and personnel support. Program elements in this category involve pre-Milestone A efforts.

Budget Activity 2, Applied Research. Applied research is systematic study to understand the means to meet a recognized and specific need. It is a systematic expansion and application of knowledge to develop useful materials, devices, and systems or methods. It may be oriented, ultimately, toward the design, development, and improvement of prototypes and new processes to meet general mission area requirements. Applied research may translate promising basic research into solutions for broadly defined military needs, short of system development. This type of effort may vary from systematic mission-directed research beyond that in Budget Activity 1 to sophisticated breadboard hardware, study, programming and planning efforts that establish the initial feasibility and practicality of proposed solutions to technological challenges. It includes studies, investigations, and non-system specific technology efforts. The dominant characteristic is that applied research is directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters. Applied Research precedes system specific technology investigations or development. Program control of the Applied Research program element is normally exercised by general level of effort. Program elements in this category involve pre-Milestone B efforts, also known as Concept and Technology Development phase tasks, such as concept exploration efforts and paper studies of alternative concepts for meeting a mission need.

The program will develop the strategy for a focused effort to execute the Materials by Design Strategy in Figure (1) for the three Electronic Materials Research Areas of interest: 1) Electrochemical Energy Devices; 2) Hybrid Photonic, Spintronic Devices; 3) Heterogeneous Metamorphic Electronics. As outlined in the executive summary, the program and Materials by Design Strategy must contain the following five Multiscale Modeling Research Core Elements:

- **Modeling and Simulation:** Validated multiscale modeling of electronic materials to design materials and predict performance by exploiting the hierarchy of scales in a multidisciplinary environment
- **Bridging the Scales: Analysis, Theory and Algorithms:** Validated theoretical and analytical analyses to effectively define the interface physics across length scales,

- **Multiscale Modeling Metrics:** Utilize existing and novel experimental methodologies to validate computational approaches in order to bridge the characteristic length and time scales, and to identify the comprehensive set of material characteristics for each of the three Electronic Materials Research Areas defined above to enable the enhancement or creation of new electronic devices
- **Validation and Verification:** Comprehensive validated experimental capabilities bridging time and space for probing the physics and mechanisms of electronic materials for verification and validation of multiscale physics modeling.
- **Processing and Synthesis:** Validated modeling and techniques for the synthesis and processing of Electronic Materials.

A number of the above Elements include experimentation. Experimentation is expected to be performed by SEDD/ARL scientists through continuous collaboration with the MSME Team. Offerors should propose plans for experimentation based on SEDD/ARL in-house materials growth, fabrication, characterization and testing capabilities and mission programs. SEDD/ARL capabilities are discussed in detail below, and more information can be found on line at www.arl.army.mil. Offerors should put forward a plan, based on but not limited by SEDD/ARL capabilities, that will provide a comprehensive experimentation component for their planned work. However, offerors should provide a rationale for using capabilities other than those currently available at SEDD/ARL.

The Materials by Design Strategy and its five Multiscale Modeling Research Core Elements are graphically outlined in Figure (1).

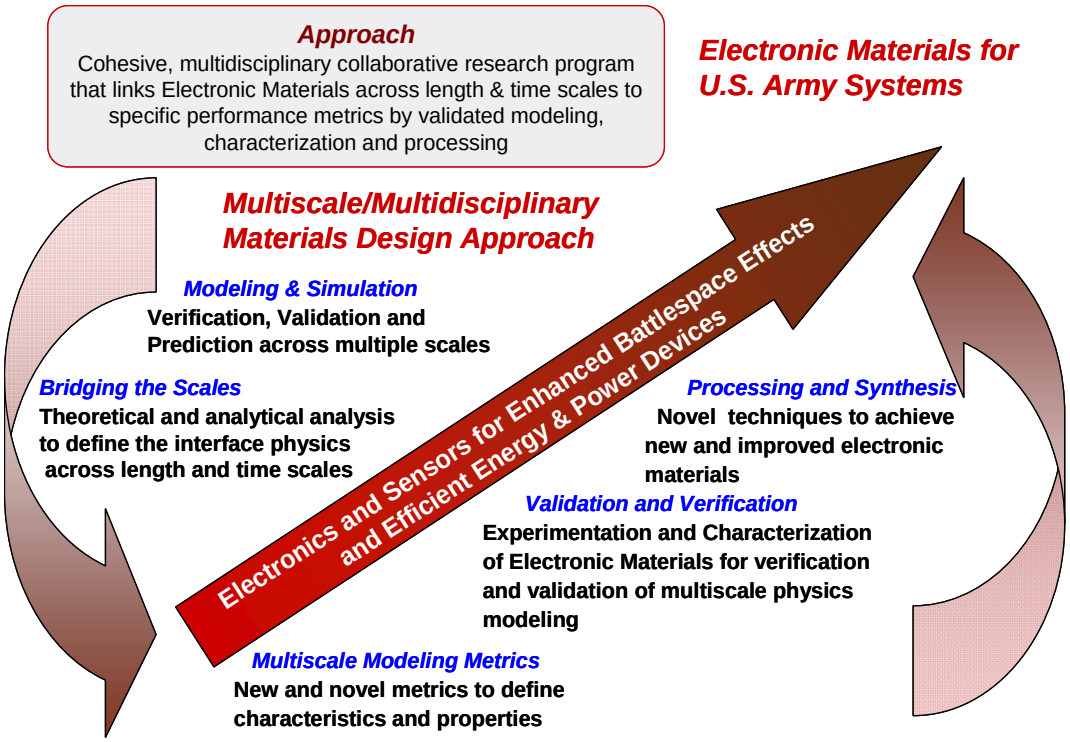

Figure (1) Materials by Design Strategy for Collaborative Research Alliance Programmatic Strategy

The offeror is advised that the government specifically envisions a CRA designed to achieve the 2, 5, and 10 year goals outlined in this PA. First, the CRA is designed to bring focus in basic research to a

problem unique and critical to the U.S. Army; i.e. materials in electronic materials. In essence, the CRA is to advance the SoA in materials science by focusing on stressing challenges in each of the three Electronic Materials Research Areas of interest. Any advances made there are ubiquitous and will advance the SoA across all aspects of materials science. It is designed to maintain and enable synergy within materials science between modeling, experimental methods, theory and analysis, synthesis within the context of multiscale research. The CRA is designed to manage basic research from a systems perspective by having all the core elements contributing to the material by design strategy. This will enhance collaboration across the Multiscale Modeling Research Core Elements. The strategy of how the Multiscale Modeling Research Core Elements interface with each other and how the materials by strategy is executed is critical to the success of the program and will be evaluated as one of the important criteria of success.

It is the responsibility of the offerors to suggest how they would optimize the use of the available funds in order to further the MSME CRA objectives. It is the intent of this PA to solicit the most creative, innovative, and flexible approaches to the ultimate goal of generating and exploiting technology to solve pressing technical issues that impact both the military and commercial sectors. Therefore, while important research issues have been suggested below, offerors may propose to alter the suggested content to further the MSME CRA goals. An offeror may propose to investigate additional research issues, or to deemphasize research issues suggested in this PA. All results of the Cooperative Agreement must be publishable without constraint in the research domain.

In response to the PA, potential offerors will be required to:

- Formulate a program to demonstrate the ability to achieve the programmatic goals of the CRA as outlined in the PA
- Define and outline the strategy for executing the materials by design strategy in Figure (1)
- Identify how the program will address Multiscale Modeling in the three Electronic Materials Research Areas: (1) Electrochemical Energy Devices; (2) Hybrid Photonic, Spintronic Materials/Devices; and (3) Heterogeneous Metamorphic Electronic.
- The program should also describe a plan for incorporating Multiscale Modeling for "Organic Hybrid Electronics" in future years.
- Identify and provide a plan for innovative crosscutting themes across both the Electronic Materials Research Areas and Multiscale Modeling Research Core Elements to advance the SoA.
- Identify a plan for Collaborative Validation and Verification with SEDD/ARL researchers, other Army organizations, other military service organizations or other government agencies.
- Identify the optimal scientific, technical, programmatic and administrative team (expected to be comprised by a number of members) with the expertise to achieve the stated goals.
- Define the metrics by which the team expects to measure success
- Identify access to facilities and assets required by the CRA
- Identify the program management plan and reporting interface to the Government

ARL and the MSME Team will establish one CRA to address research topics in Electronic Materials for new and improved electronic devices in applications such as sensing for enhanced battlespace effects, sensing and processing, and efficient power and energy. However, research results are expected to support all aspects of material science broadly across a spectrum of materials classes. Additionally, other Government agencies will be invited to join this Alliance, to contribute, as appropriate, their technical expertise and personnel, and to participate in the MSME CRA. This intellectual synergy may include sharing equipment, personnel and facilities to promote efficiency and collaboration. A significant goal of this effort is to create a critical mass of academic, private sector and Government scientists and engineers focused on solving the research challenges outlined within the scope of the CRA.

Multiscale Modeling of Electronic Materials CRA Vision

This PA will result in a the establishment of the Collaborative Research Alliance (CRA) on Multiscale Multidisciplinary Modeling of Electronic Materials, for quantitative understanding of materials from the smallest to the largest relevant scales to create new and improved electronic device applications to include sensors for enhanced battlespace effects, sensing and processing, and efficient power and energy. The goal is to realize "Materials by Design" capability through the MSME CRA in each of the three Electronic Materials Research Areas: 1) Electrochemical Energy Devices, 2) Hybrid Photonic, Spintronic Devices, and 3) Heterogeneous Metamorphic Electronics.

2-Year Goals:

Advance the fundamental understanding and implementation of Physics-Based Modeling of Electronic Materials across both time and space to develop a set of algorithms/theories for a broad range of electronic materials to create new and/or improved electronic devices, and advance the understanding of existing performance. Potential 2-year outcomes include:

- Multiscale models and algorithms that enable better understanding of material, electronic, optical and opto-electronic properties of Col IV, III-V, and II-VI semiconductor materials and devices for sensors and sources from 0-dimensional confinement up to 3-D
- Multiscale models and algorithms that predict the bulk and interfacial properties of fuel cells for development of novel low cost catalysts for fuel cells.

Benefit to the Soldier: Resulting models and algorithms will enable the advancement of sensors and power and energy devices on the battlefield.

5-Year Goals:

Integrate new multidisciplinary /multi-scale physics to enable multi-scale modeling and simulation capability that is validated experimentally in time and space to apriori design new or improved electronic materials that are uniquely characterized, synthesized and processed.

Potential examples of enhanced SoA resulting from the advancement or development of new theories and algorithms of MSME could include:

- Multiscale models that lead to the development of new generation high voltage rechargeable lithium ion batteries with improved energy and power density based on novel electrolyte formulations that are compatible with novel high voltage cathode materials.
- Develop algorithms and theory of dislocations, interfaces, and surfaces within semiconductor materials and devices for improved device efficiency.

Benefit to the Soldier: Resulting models and algorithms will enable the development of new sensors and power and energy devices on the battlefield.

10-Year Goals:

Advance the state of the art in multiscale modeling and electronic materials to create a capability for "Materials Optimization and Materials by Design". Potential 10-year outcomes include:

- Deploy Multiscale Models for a variety of electronic materials that can be shared within the scientific community
- Higher performing (longer-lived) batteries by ~ 30% with more than double to treble the energy density
- Increase efficiency by 20%, with a fivefold increase in lifetime for UV solid state sources
- One order of magnitude reduction in dislocation density for IR detectors on Si → 10X reduction in FPA cost

Benefit to the Soldier: ARL will exercise "Materials by Design" capability to design new sensors and power and energy devices for the battlefield that are more efficient, have longer lifetimes at a lower cost.

4. Multiscale Modeling Research Core Elements

The objective of this CRA is to conduct fundamental research to create MSME to support development of future electronic materials and devices for the Army. These models are needed to create new understanding and improved electronic device applications to include sensors and electronics for enhanced battlespace effects, and efficient power and energy devices. Offeror's are expected to provide a plan to perform the following five Multiscale Modeling Research Core Elements for each of the three Electronic Materials Research Areas discussed below: 1) Modeling and Simulation, 2) Bridging the Scales, 3) Multiscale Modeling Metrics, 4) Validation and Verification, and 5) Processing and Synthesis. To achieve this, the Alliance is expected to advance the fundamental science and state-of-the-art (SoA) for Multiscale Multidisciplinary Models in each of the Electronic Materials Research Areas: 1) Electrochemical Energy Devices, 2) Hybrid Photonic, Spintronic Devices, and 3) Heterogeneous Metamorphic Electronics. Innovative crosscutting themes across both the Electronic Materials Research Areas and Multiscale Modeling Research Core Elements are envisioned to advance the SoA as part of this initiative. The intent is for the Multiscale Models to be developed by the MSME Team, where validation and verification will be performed through collaboration with ARL scientists in each of the three Materials Research areas.

The following paragraphs discuss research issues in the five Multiscale Modeling Research Core Elements that the U.S. Army considers important for modeling the three Electronic Materials Research Areas discussed below.

a. Modeling and Simulation: multiscale modeling (predicting performance and designing materials) including multiscale information transfer between modeling and experimental results. The U.S. Army has the long-term strategy to advance the state of the art in computational electronics materials modeling across the scales both from a Multiscale and Multidisciplinary perspective. The strategy is to develop the material science and computational capability to exploit the scales from quantum through the continuum to provide a predictive capability. The result of the research should include a robust suite of recommended and validated models and codes at all of the length scales appropriate for use in the three major Electronic Materials Research Areas discussed below. The offeror should consider the following as well as any and all other approaches to propose a modeling and simulation thrust that is consistent with the overall program strategy and is integrated across all of the Multiscale Modeling Research Core Elements.

- Modeling and simulation codes and algorithms from the atomic scale to the macro-scale (continuum).

- Validated mathematics, physics based algorithms and protocols for moving between all of the scales are required.
- Techniques for embedding models and algorithms into continuum codes.
- Analysis, approach and recommendations for using a multi-scale hierarchical or concurrent methodology
- Development of physics based models and algorithms for embedding into meso-scale and continuum codes.

b. Bridging the Scales: Theoretical and analytical analyses to effectively define the interface physics across length scales

The U.S. Army believes that a successful comprehensive program to enable a Multiscale Multidisciplinary Modeling of Electronic Materials requires a parallel and concurrent effort in analysis, theoretical mathematics and algorithms. This aspect of the program should work to (1) extract, evaluate and correlate experimental results either from collaborative efforts with ARL or through published results, (2) theoretically link materials micro, meso and macrostructure across scales and disciplines, (3) provide the foundation for new numerical modeling algorithms, and (4) provide physics insight into equations of state and continuative equations. The offeror should consider the following as well as any and all other ideas and theoretical/mathematical concepts.

- Novel mathematical theories/algorithms that link the fundamental governing equations across scales with the long-term goal to have a unified set of governing equations that are asymptotically valid across scales-specifically across the interfaces between scales or materials
- Novel mathematical theories/techniques linking the fundamental governing equations, equations of state and constitutive equations across scales and disciplines that can be used to optimize information transfer due to disparate length and time scales
- Novel deterministic and stochastic to data manipulation and correlation in both modeling and simulations as well as experimental analysis and code validation
- New and novel mathematical techniques that would be the basis for optimum numerical algorithms in a Multiscale/Multidisciplinary environment
- Novel mathematical methodology for enhanced computational techniques
- New mathematical techniques for manipulation and analysis of experimental data for validation and verification needed to understand the capabilities of modeling in a multiscale/multidisciplinary environment

c. Multiscale Modeling Metrics: Utilize existing and novel experimental methodologies to validate computational approaches in order to bridge the characteristic length and time scales, and to identify the comprehensive set of material characteristics for each of the three Electronic Materials Research Areas defined above to enable the enhancement or creation of new electronic devices.

It is important to be able to describe in detail deterministically and stochastically the characteristics of a material so it can be processed and/or synthesized. The current SoA of this aspect of material science is thoroughly founded for materials subjected to static or slowly varying conditions. The offeror is to consider developing advanced deterministic and stochastic metrics that define the desired properties, microstructure and characteristics for:

- Material properties in time and space
- Material characteristics, defects and mechanisms allowed statically as well as in time and space

d. Validation and Verification: Comprehensive validated experimental capabilities bridging time and space for probing the physics and mechanisms of electronic materials for verification and validation of multiscale physics modeling.

e. Processing and Synthesis: Validated modeling and techniques for the synthesis and processing of Electronic Materials.

A number of the above Elements include experimentation. Experimentation is expected to be performed by SEDD/ARL scientists through continuous collaboration with the MSME Team. Offerors should propose plans for experimentation based on SEDD/ARL in-house materials growth, fabrication, characterization and testing capabilities and mission programs. SEDD/ARL capabilities are discussed in detail below, and more information can be found on line at www.arl.army.mil. Offerors should put forward a plan, based on but not limited by SEDD/ARL capabilities, that will provide a comprehensive experimentation component for their planned work. However, offerors should provide a rationale for using capabilities other than those currently available at SEDD/ARL

5. Electronic Materials Research Areas

Material properties of principal interest are electromagnetic and optical, and properties of secondary interest include acoustic, chemical, and mechanical as they are necessary to evaluate the principle properties of interest or to develop rigorous models. For proposals to be considered responsive, they must include Multiscale Multidisciplinary Modeling in each of the three Electronic Materials Research Areas below:

- **Electrochemical Energy Devices**—focus on interfacial physics and chemistry; solid-liquid interface—clear opportunities for batteries, capacitors, fuel cells, etc
- **Hybrid Photonic, Spintronic Devices**—interaction of photons, electrons, phonons—areas such as photonics, spintronics, plasmonics, and phonons
- **Heterogeneous Metamorphic Electronics**—mixed materials, with partial ordering—includes graphene, metamaterials, nanoelectronic structures, etc.

The specific electronic materials to be modeled for this CRA are up to the discretion of the offerors, but they must fall within the three Electronic Materials Research Areas above. Offerors should provide supporting arguments as to the significance, Army Relevance, and potential scientific and technological payoff of the electronic materials in their proposal. Offerors should also provide a plan for validation and verification specific to the materials selected through collaboration with ARL researchers.

a. Electrochemical Energy Devices

ARL has identified a number of challenges in electrochemical energy storage and generation that can be effectively addressed through this CRA. Examples of materials and devices of particular interest to ARL in this Electronic Materials Research Areas are Lithium-ion Batteries; Alkaline Membrane Fuel Cells; and Solid Oxide Fuel Cells (offerors may suggest other areas for research, but need to provide supporting arguments for justification).

Lithium ion batteries. Modern batteries require storage of more energy per unit volume and weight, faster charge and discharge for many thousands of charge-discharge cycles. New electrolyte and electrode materials are needed for radical improvement in energy and power density of lithium ion batteries. Currently there is a general lack of understanding regarding the influence of electrolyte components (salts, solvents, additives) on molecular interactions and physical properties (ionic conductivity, viscosity, volatility) and how electrolyte properties influence device performance. Understanding these fundamental properties and interactions will enable design of new electrolytes that are tuned for specific electrode-electrolyte systems and diverse applications in regeneration and storage of energy. Thus, there is an increased need for reliable, transferable and validated multiscale simulation tools and methodologies that would effectively aid experimental efforts in obtaining fundamental understanding of the complex and interrelated electrochemical phenomena occurring in electrodes, electrolytes and at their interface.

Alkaline Membrane Fuel Cells. The Army is considering the AMFC as a low temperature fuel cell for operations with low to intermediate power requirements. The AMFC uses a polymeric alkaline anion exchange membrane (AAEM), which has alkaline-supporting functional groups to promote ionic transport. It is of interest because of the improved electrochemical kinetics offered by the alkaline conditions, including the use of a non-precious metal catalyst. However, there are challenges with the AAEM and electrochemical interfaces that are multiscale in nature and need to be addressed. Multiscale simulation can provide mechanistic details that are difficult to address experimentally regarding processes in the AMFC and can accelerate synthesis and development efforts.

Solid Oxide Fuel Cells. The SOFC is a technology of interest for a range of power requirements. The benefits offered by the SOFC include high efficiencies, availability of useful heat, and ability to use a variety of fuels including processed logistics fuel. However, there are several challenges with SOFC stability. These challenges include issues associated with the chemical, thermal, and mechanical stability of the cell and its constituent materials and structures. Multiscale simulations are well suited for these studies based upon their ability to provide advanced details regarding mechanisms and pathways of these processes, which are difficult to ascertain by experimental methods, providing insights into means to mitigate.

b. Hybrid Photonic, Spintronic Devices

Multiscale modeling initiatives are sought that address photonics, spintronics, and plasmonics by modeling the interaction of photons with electrons and phonons. Approaches may be multiscale in both space and time, and may span the wavelength range from millimeters to nanometers. Research is sought on the integration of first principle calculations of electronic band structure with continuum models that can predict macroscopic device performance by taking into account potential fluctuations and nanoscale compositional inhomogeneities in random and ordered alloys, as well as spontaneous and piezoelectric polarization as a function of crystal orientation, including anisotropy in optical and transport properties. Additional length scales created by the introduction of photonic cavities and periodic or aperiodic structures are also of interest. In a similar way, a microscopic understanding of magnetic properties linked to a macroscopic description of spintronic devices is sought. In addition, an integrated approach is sought to model linear and nonlinear electronic and optical processes over multiple time scales that range from microscopic carrier-carrier, carrier-phonon and carrier-trap interactions on femtosecond to picosecond time scales to

nonradiative and radiative recombination lifetimes on picosecond to nanosecond time scales, with correlation to device lifetimes that range from hours to years. Phonon-phonon interactions which lead to microscopic heat generation and their relation to macroscopic thermal management in devices is also important. Prediction of defects on the microscale (e.g., interface roughness, threading dislocations, stacking faults, point defects, traps) and their impact on device performance and noise on the macroscale are of particular interest, especially in materials on non-native substrates, as well as for optical and spin coherence in spintronic and quantum logic devices.

c. Heterogeneous Metamorphic Electronics

Research in this Electronic Materials Research Area should yield multi-scale models necessary to describe and predict the interactions between the extrinsic factors of metamorphic materials (e.g. size, shape, adjacent materials, etc.,) and their intrinsic properties. Metamorphic materials are traditionally defined as engineered materials (e.g. meta-materials and super-lattices) whose properties are primarily determined by extrinsic factors. However, in this PA the description shall be extended to describe other synthesized nanometer scale materials (e.g. graphene and nano-tubes, -wires, and -rods) that also experience extrinsic factors that determine their intrinsic performance. Additionally, heterogeneous structures, where adjacent layers' intrinsic properties are so dissimilar as to substantially alter performance, are included in the general classification.

For material systems in this area, it is not possible to examine their intrinsic properties without consideration of their extrinsic environment. Additionally, the extrinsic-intrinsic interactions, which occur at one scale (either in space or time) can drastically affect performance at different scales. Accordingly, it is first necessary to understand and capture the physical phenomena governing interactions between extrinsic factors and intrinsic properties, and then to extend those relationship across scales.

In addition to extrinsic-intrinsic interactions, these material systems experience phenomena across extreme scales. For example, defect states at the atomistic, or even quantum, level can influence substantially the performance of a fully integrated electronic system. Some examples of materials and devices of particular interest to ARL in this Electronic Materials Research Area are meta-materials, graphene, and integrated heterogeneous electronic structures.

d. Innovative Crosscutting Themes

Offerors should identify and provide a plan for crosscutting themes that will enable innovative research across the electronic materials and multiscale modeling research areas put forth in this CRA. Examples of crosscutting themes could include areas such as computational algorithms, computational mathematics, petascale computing and data analysis, surfaces, defects and interfaces; where advancements would crosscut and apply to more than one materials system. Proposals should include discussion as to how these crosscutting themes will drive technology advancements required to push the science forward.

e. Organic Hybrid Electronics (future years)

For this topic area, ARL is only asking for a plan to incorporate multiscale modeling for "Organic Hybrid Electronics" in future years, to start at the beginning of FY16. The Army

has made investments in the development of flexible electronics that include; organic, hybrid-organic and inorganic electronics that are heterogeneously integrated with electro-optic devices for sensors, imaging, and displays. Flexible electronics has broad impact for rugged, light weight information displays, circuits, large area sensors, imaging devices, and energy harvesting. Some areas of interest for multiscale modeling are charge injection and transport, grain boundary effects, defects, crystallinity, maximal room temperature carrier mobility similar to that of inorganic semiconductors, cycling stress-effects, long time-scale relaxation effects, and operating lifetimes, carrier diffusivity, recombination, quenching, trapping and annihilation rates of excitons, transport models for disordered systems, improved light extraction in optoelectronic devices and applications, quantum efficiency, and quantum optics, charge generation; field effects on carrier transport, charge collection, solar spectrum match for organic photovoltaic cells and macromolecules, photo-conducting detectors; charge injection and transport through single molecules, photo-degradation and device lifetimes, device and systems-level reliability and feasibility of electrically pumped and micro-ring organic lasers, and conversion efficiencies and lifetimes for low-cost, energy-efficient lighting. New modeling and simulation approaches for bandwidth theories, band calculations, coupling constant determination, nano-scale effects, and polaron phenomena are of interest.

6. ARL SEDD In-House Capabilities

The following information provides SEDD's experimental and analytical capabilities and facilities, and is intended to provide the offerors the necessary information for creating a collaborative research plan for modeling requirements pertaining to the "Validation and Verification" and "Processing and Synthesis" described above. SEDD's research and development facilities and capabilities include equipment to support Nanotechnology, Material Growths, Electrochemistry, Biotechnology, -80°C Dew Point Dry Room, Specialty Electronic Material and Sensors Cleanroom, Image Processing, and Field Tests/Ranges.

Specialty Electronic Materials and Sensors Cleanroom
ARL has 14,800 square feet of class 10 and class 100 cleanroom available for NEMS, MEMS, advanced specialty semiconductor materials, nanoelectronics, optoelectronics, sensors and electron device fabrication.

- i-line Lithography
- E-beam direct write for nanoscale devices
- Metal and Dielectric Deposition
- Inductively Coupled Plasma Reactive Ion Etching
- LPCVD High-Temperature Thermal Processing and Wafer Bonding
- Vapor Phase HF and XF_2 Isotropic Etching for Device Release
- In-Process Material and Device Characterization
- Piece Part to 6" Wafer Capable
- Wide range of applications and substrate materials such as: Silicon, III-V, Polysilicon, AIN, Piezoelectrics

Microanalysis
ARL has a fully staffed facility available to access physical, chemical, and structural properties of electronic and optical materials and devices.

- Transmission Electron Microscopy
- Atomic Force Microscopy

- Micro Raman Spectroscopy
- X-Ray Diffraction
- Focused Ion Beam
- Secondary Ion Mass Spectroscopy
- Scanning Electron Microscope
- Auger/XPS Spectroscopy

Molecular Beam Epitaxy and MOCVD
ARL has eight MBE chambers for II-VI, IV-VI, and III-V and two MOCVD for III-V electro-optical material deposition. Applications include sensors, optical emitters, thermoelectric materials and electronic components.

- Mercury Cadmium Telluride
- Lead Tin Telluride
- Gallium Arsenide
- Indium Phosphide
- Gallium Antimonide
- Gallium Nitride
- Silicon Carbide
- MOCVD Ammonia Pre-Cracking Capability

Electrochemistry Laboratory

Image Analysis and Processing Laboratory

Chemical Reformer Laboratory

MEMS Exchange

- DoD supported intermediary for fabrication of MEMS/NEMS devices.
- U.S. government business or academic may create a fabrication run to be performed by the MEMS Exchange network of foundries.
- ARL is the only government fabrication facility that is part of this network.
- All available processes and prices can be found on the MEMS Exchange web site: www.mems-exchange.org.

Discover More: For more information about the SEDD organization, please visit: www.arl.army.mil/sedd

Computational Resources (CISD)

- Defense Supercomputing Resource Center (DSRC)
    - As of FY10, 350 TeraFlops
        - 2 SGI ALTIX ICEs
        - Cray XT5 Cluster
        - 2 Linux NetworXs
    - Extensive Library of Applications
        - Computational Chemistry and Materials Science
        - Computational Structural Mechanics
        - Programming and System Tools

- Scientific Visualization

7. Funding

Table 1 presents the estimated funding levels for the CA over the projected period of performance, including option years. The projected funding includes all costs associated with the CA, i.e. the research costs, costs to manage the program, develop and maintain modeling methods, etc. The table makes two key assumptions: (1) award of the cooperative agreement will be in the 2nd quarter of FY12 and (2) the program will ramp up with start-up activities during the second quarter resulting in less than full funding during the initial fiscal year of operation (i.e., the funding identified for FY12 in Table 1 is the amount of funding anticipated for the start-up year and as such it is less than the annual funding for subsequent years). The Table also contains proposed guidance for Enhanced Program funding. This is currently unfunded. As the CRA proceeds, it is anticipated that other government agencies will be able to provide funding for these lines.

Additionally, it is required that "covered educational institutions" (to include Historically Black Colleges and Universities and Minority-Serving Institutions or HBCU/MSIs – see also **PART II.C.1** below) receive 5-10% of the annual funding under the cooperative agreement

Since fundamental research in any aspect of material science draws upon a broad palette of science and engineering, it is expected that performance will be enhanced by a constantly changing group of additional researchers and research organizations (subawardees) chosen jointly by the MSME Team and the Government to foster new ideas, innovation and thus complement research already undertaken by the MSME Team and the Government. To insure these new ideas and innovations are a core element of the CA at least five percent (5%) of the annual research effort is expected to be devoted to novel and innovative research conducted by the subawardees. The Alliance will also be able to seek opportunities for basic and applied research from other government agencies that enhance and or parallel the core basic research program of the CRA.

Funding Category	Core Research Program ($M) Fiscal Year											
	FY12	FY13	FY14	FY15	FY16	**Total (5yr)**	FY17	FY18	FY19	FY20	FY21	**Total (10yr)**
Basic Research ($M)	2.0	3.0	3.0	2.4	2.0	**12.4**	2.0	2.0	2.0	1.5	1.0	**20.9**
Core Total ($M)	2.0	3.0	3.0	2.4	2.0	**12.4**	2.0	2.0	2.0	1.5	1.0	**20.9**
	Enhanced Research Program ($)											
Basic Research ($M)	0.25	0.25	0.25	0.25	0.25	**1.25**	0.2	0.2	0.2	0.2	0.2	**2.25**
Applied Research ($M)	0.25	0.25	0.25	0.25	0.25	**1.25**	0.2	0.2	0.2	0.2	0.2	**2.25**
Enhanced Total ($M)	0.5	0.5	0.5	0.5	0.5	**2.5**	0.4	0.4	0.4	0.4	0.4	**4.5**
Total ($M)	2.5	3.5	3.5	2.9	2.5	**14.9**	2.4	2.4	2.4	1.9	1.4	**25.4**

Note: Total Funded 10 Year Core Program $20.9M
Total Funded 10 Year Core and Unfunded Enhanced Program $25.4M

Table 1. Anticipated CRA Funding
(Funded Core Research Program and Unfunded Enhanced Research Program)

Enhanced Program

The understanding of MSME is required all across the DOD so an unfunded Enhanced Program is being included in this PA. This will provide for a mechanism within the CRA for growth and enhancement. ARL, the Army and other government agencies may chose 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 be to leverage parallel and/or transition the research, technology and capabilities that are the core of the ARL funded CRA. **In response to this PA, offerors are requested to provide a detailed proposal to address the entire core research program at the core level of funding. In addition, offerors are asked to include a general discussion of possible additional research that could be pursued should funding be received to enhance the CRA effort. (See the Cost Proposal discussion below for further guidance on this.)**

8. Collaboration

a. Background

Experience has shown that for many emerging technologies, high payoff is achieved through collaboration with a broad science and technology community. The U.S. Army Collaborative Technology Alliances (CTAs) were designed to encourage collaboration. The MSME CRA continues the ARL concept of an Alliance to facilitate a close relationship between ARL and its partners so that collaborative research can leverage and enhance individual efforts. It is ARL's strong belief that work conducted under the MSME CRA cannot be successful either

in whole or in part without collaboration. That is, collaboration between the MSME Team and the Government Members of the Alliance is integral to the execution of the CA. Creation of an environment that is conducive to collaboration is therefore a critical element in establishing the Alliance. This section describes potential means to establish a collaborative environment including outreach activities and an on-line presence wherein scientific ideas can be exchanged efficiently in an open environment amongst the Alliance. Offerors are invited to suggest additional new and innovative means for fostering collaboration among Alliance as part of their proposal.

b. Collaborative Experimentation

Experimentation is to be performed by ARL scientists in each of the three Materials Research Areas. These results will be shared within the Alliance and are expected to be part of a continual process to improve and create new models through collaboration between ARL and the MSME Team. Offerors need to provide a plan for collaborative experimentation as part of their proposal.

c. ARL In-House Initiative for Multiscale Modeling of Materials (I3M)

This CRA is part of the ARL Enterprise for Multiscale Research of Materials. The Enterprise will include an in-house ARL Initiative for Multiscale Modeling of Materials (I3M) that will be established prior to the CRA awards. The long term goal of the I3M is to develop new physics-based scientific multidisciplinary multiscale modeling methodologies and software that can interrogate design space in which material imperfections, surface and interfaces (ISI's) are prominent enablers or detractors for performance. The I3M will be a partner in collaboration with the CRAs. It is envisioned that this Enterprise effort will provide the Army and DoD fundamentally new cross-cutting capabilities (high level physics-based computational tools) that will help overcome obstacles for materials development relevant to energetics, sensors, electronics, power, modeling and simulation applications. This I3M will also provide access to advanced high performance computing capability, computing environments, validated codes and software, visualization suites, and data management techniques that can be leveraged by the CRAs.

d. Lectures, Workshops, and Technical Reviews

The Alliance may hold, from time to time throughout the period of performance of the MSME CRA Program, scientific lectures and workshops on mutually agreed upon topics. These lectures and workshops will serve as both educational and technical outreach opportunities and could involve participants outside the Alliance when appropriate. Additionally, the Alliance is expected to hold regular, periodic scientific reviews that will permit the free exchange of ideas and research results, especially those impacting crosscutting research themes, among the entire ARL Enterprise for Multiscale Research. The costs associated with the MSME Team efforts for these lectures, workshops and scientific reviews will be funded under the CA.

e. Other Government Agencies (OGAs)

The Government will work with the LRO to leverage and/or integrate other interested OGA's into the CRA umbrella. These efforts and thrusts may be lead by the LRO, Partners or coordinated jointly. The offeror is free to propose leverage of and/or utilization of unique facilities and or capabilities available within OGA's. Other service elements such as the Air

Force and Navy and U.S. Army Research and Development Centers such as the U.S. Army Research Development and Engineering Center, (ARDEC), the U.S. Army Aviation and Missile Research and Development Center (AMRDEC), the Natick Soldier Research Development and Engineering Center (NSRDEC) and the U.S. Army Communications Electronics Research Development and Engineering Center (CERDEC) also have requirements for electronic device applications to for enhanced battlespace effects, and efficient power and energy devices.

f. Education

As a means to foster the professional growth and scientific strength of ARL and to provide a source for training personnel in fields underlying the Alliance, the MSME Team will identify educational opportunities for Government scientists and engineers who perform research and development in fields related to the CA. These opportunities may include fellowship programs that lead to masters and doctoral degrees, and short courses (e.g., summer and intensive special topic courses in critical technology areas) that lead to the award of appropriate academic credit.

The MSME Team will further consider means to foster collaboration with ARL scientific staff through programs such as internships at ARL for graduate and undergraduate students, and sabbaticals and summer study for faculty. The costs associated with the MSME Team's efforts to identify, prepare for and execute such educational opportunities will be funded under the CA. The cost associated with salaries, travel, etc. for Government personnel will be the responsibility of the Government, and will not be funded under the CA.

g. Opportunities for Research Collaboration and Staff Rotation

A foundation of the CRA process is the rotation of scientific staff through short- and long-term temporary assignments among the Alliance. 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, to permit close, direct interaction between research partners, and to facilitate the exchange of research results. In addition, this exchange, or cross fertilization, of personnel will provide Alliance personnel with insight into Army unique requirements and will provide Government personnel with insight into commercial practices or the opportunity to pursue fundamental research with noted researchers. The success of these interactive and collaborative exchanges will be assessed by the quality of the collaboration as demonstrated by joint efforts such as archival journal papers, patents, and refereed presentations. In the proposal, offerors should outline the range of opportunities foreseen for collaboration and the mechanisms that will be put into place to foster staff rotations.

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 MSME Team will be funded under the CA. There should be a balance of staff rotations across CRA and across all the research areas. It is anticipated that some portion of the MSME Team's technical labor-years will be in staff rotations. Costs for staff rotation and collaboration should be clearly evident in cost proposals and budgets submitted for the MSME CRA.

h. Other Collaboration Opportunities

High Performance Computing DoD Supercomputing Resource Center (HPC-DSRC) (http://www.arl.hpc.mil/)

ARL is a partner with the DoD High Performance Computing Modernization Program Office (HPCMPO) to manage and operate one of its three DoD Supercomputing Resource Centers (DSRCs). As one of the world's most powerful computing sites, the ARL DSRC delivers the latest in computational tools and innovative technology. Our computer simulations and models help technologists develop, test new and improved electronic device applications to include sensors and electronics for enhanced battlespace effects, and efficient power and energy devices. The ARL DSRC also uses world-class, high-performance computers (HPCs), cutting-edge applications, and expert staff scientists to help the United States maintain its technological and military supremacy. The Center offers a full spectrum of computational capabilities for the Department of Defense (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
* Novel storage platforms
* Close ties with academic partners
* Advanced training
* Outstanding end-user care

The MSME Team can request access to the DSRC under the CRA umbrella to utilize the computational, and visualization resources.

9. Management

a. Overall Management Concept

ARL and the MSME Team will establish one collaborative research Alliance to address issues concerning the MSME CRA. Additionally, other Government agencies may be invited to join this Alliance and to contribute, as appropriate, their technical expertise and personnel, and to participate in the MSME CRA. The proposal must identify Research Leads for each of the three Electronic Materials Research Areas discussed above. The Research Leads can come either from the LRO or from the Key Subawardees. Each of the three Research Leads will be responsible for scientific leadership in their respective research area, in coordination with the Alliance. In addition, the Proposal must identify a Program Manager (PM) that will be the technical representative charged with the overall responsibility for management and guidance of the CA. The PM will reside with the Lead Research Organization (LRO).

The Alliance is expected to continually renew itself by scouring the research community for new, relevant and innovative ideas and concepts that might enhance the research program. Thus, in addition to research conducted by organizations included in the selected proposal, it is expected that the annual research program will be enhanced as appropriate by research undertaken by other organizations selected jointly by the Alliance as part of its annual planning process.

A framework for agile and adaptive leadership should be utilized by MSME management team for the research effort. Most project managers work in a hierarchical organization where assignments come from the top down. In an agile and adaptive project leadership environment, this hierarchy can be counterproductive. The concept of agile and adaptive leadership pivots on the idea that assignments and work flow should be determined by the highly skilled team members whose primary responsibility is to deliver customer value. Thus, agile and adaptive leadership focuses on people, strategies based on specific situations, and continuous feedback. Importantly, this leadership style calls for recognizing people as the ultimate source of value in an organization, and thus for managing them differently. To realize the agile and adaptive leadership style, a "Light Touch" leadership style that carries the potential for unleashing creativity and innovation is in order. This “Light Touch” leadership approach means managers must allow agility, autonomy and flexibility without sacrificing control.

b. Technical Guidance and Oversight

The following framework is required for the management and oversight of the Alliance. It consists of parallel managers from the Government and the LRO who will provide day-to-day coordination and a consultative group of interested parties from the Government. Offerors may propose additional plans or mechanisms for management; however, offerors 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 Alliance Management follows:

- **Collaborative Alliance Manager (CAM)**. The CA executed under the MSME CRA will be considered an extension and integral part of the ARL research program. As such, the program established under this PA will be planned, defended, executed, and reviewed as part of ARL’s mission program. Overall, technical management and fiscal responsibility for the MSME CRA will reside with a senior ARL technical manager, who will be designated the CAM for the MSME CRA under the cooperative agreement. The ARL Grants Officer will receive recommendations from the CAM and will be the ultimate legal authority empowered to make formal adjustments in the MSME CRA, for the CA.

- **Program Manager (PM)**. The MSME CRA PM is the LRO’s scientific representative charged with the overall responsibility for management and guidance of the cooperative agreement. The MSME CRA is expected to be the primary responsibility of the individual assigned as PM, and a commitment of time commensurate with this responsibility is also expected. The PM is expected to be an eminent scientist in areas related to the MSME CRA. The PM may need to reduce any teaching schedule commitments commensurate with the duties required to manage the CRA. It is also recognized that the PM may require staff support to manage and execute the cooperative agreement, and this should be included in the CRA proposal submission.

- A **Research Management Board (RMB)** will be established to identify and develop collaborative opportunities, advise and assist the CAM in setting research goals, and facilitate transition to ARL basic and applied research programs. The RMB will be chaired by the CAM and will include representatives from Army, other service organizations and other government agencies with interest and expertise in the technologies related to the CRA. The RMB will be informed about the Annual Program Plan approval process.

c. Initial Program Plan (IPP) and Annual Program Plan (APP)

Within 90 days after award, the LRO, Partners and the Government will jointly prepare an Initial Program Plan (IPP) to cover the first 9 months of performance. The IPP will be based substantially on the final proposal received from the Offeror. The IPP will be accompanied by a five-year roadmap that describes the overall plan to be accomplished by the MSME Team within the Alliance structure. This roadmap should provide the vision for grand challenges and crosscutting themes to be addressed during the first five years of the Alliance. The roadmap should provide a detailed description of a well-coordinated plan of technology development and application, balancing theoretical and experimental elements of the program in each of the three Electronic Materials Research Areas.

Eight months after award, the LRO, Partners and the Government will jointly prepare a proposed Annual Program Plan (APP) for the next fiscal year. Through discussion among the Alliance, an APP will result that enables integration and execution of crosscutting themes that strive to achieve MSME CRA objectives. The CAM will approve the APP and formally submit the approved APP to the Grants Officer for incorporation into the CA. This process will continue through the life of the CA.

Each APP will cover a one-year timeframe, but may be altered, with the approval of the CAM and the Grants Officer, if research work requirements change. The APP will provide a detailed plan of research activities (including research goals, key personnel, educational opportunities, staff rotation, facilities, demonstrations and budget) that commits the MSME Team to use their best efforts to meet specific research objectives. The APP will also describe the collaborative efforts with the Government. During the course of performance, if it appears that research goals will not be met, the LRO will provide a proposed adjustment to the APP for approval by the CAM. In addition, the CAM may from time to time request that additional research be added to the APP within the scope of the CA.

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

- Changes in the scope or the objective of the program, IPP/APP, or research milestones;
- Change in the key personnel specified in the IPP/APP;
- The absence for more than three months, or a 25% reduction in time devoted to the project, by the approved 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/APP.

The CAM, in coordination with the LRO and ARL management, will be responsible for integrating the IPP/APP into the overall respective research and technology programs.

d. Evaluation For Five-Year Extension

The MSME CRA will be awarded for a five-year period beginning in FY12. There will be an option to extend the MSME CRA for an additional five years. At the end of the fourth year, a program review will be conducted as directed by ARL. This review will consider cumulative performance metrics, the LRO and Partners vision for the additional five-year period of

performance (to be submitted by the LRO at the end of the fourth year), funding availability and the current fundamental research needs and goals of the US Army. Performance metrics are expected to include items that provide an indication of the MSME CRA's accomplishments such as the number of refereed journal articles, invited presentations, relevance of the work to ARL, collaboration, staff rotation, education, management**,** etc. The decision as to whether to exercise the option is expected to be based on the results of the review and evaluation described above.

B. AWARD INFORMATION

One CA will be awarded as a result of this PA. Should your proposal be selected for award, you will be contacted telephonically or via email by the Grants Officer or his/her representative. At that time the offeror will be asked to execute the Cooperative Agreement. Award is not made until the CA is signed by both the successful offeror and the Grants Officer. Substantial Government involvement is expected as described under the COLLABORATION section above.

C. ELIGIBILITY INFORMATION

1. Eligible Applicants

The CA will be awarded to a Recipient (i.e. LRO) that must be an academic institution, with the participation of Key Subawardees that can be academic, industrial and non-profit organizations. Since fundamental research in any aspect of material science draws upon a broad palette of science and engineering, it is expected that performance will be enhanced by a constantly changing group of additional researchers and research organizations (subawardees) chosen jointly by the LRO, Partners and the Government to foster new ideas, innovation and thus complement research already undertaken by the MSME Team and the Government. To insure these new ideas and innovations are a core element of the CA at least five percent (5%) of the annual research effort is expected to be devoted to novel and innovative research conducted by the subawardees. In addition, covered educational institutions must receive 5-10% of the annual CRA funding. The LRO, Key Subawardees and the other subawardees make up the MSME Team.

To be qualified, a potential applicant must:

- Have the management capability and adequate financial and technical resources, given those that would be made available through the CA, to execute the program of activities envisioned under the CA.
- Have a satisfactory record of executing such programs or activities (if a prior recipient of an award).
- Have a satisfactory record of integrity and business ethics.
- Be otherwise qualified and eligible to receive a cooperative agreement under applicable laws and regulation.

In deciding whether a recipient is otherwise qualified, the Grants Officer shall ensure that the potential recipient: is not identified in the Government-wide Excluded Parties List System (EPLS) as being debarred, suspended, or otherwise ineligible to receive the award; has provided all certifications and assurances required by Federal statute, Executive order, or codified regulation, unless they are to be addressed in award terms and conditions at the time of award; and meets any eligibility criteria that may be specified in the statute authorizing the specific program under which the award is being made.

Lead Research Organization (LRO):

The LRO is required to be an academic institution. The academic institution is expected to be an advanced degree-granting educational institution under the Higher Education Act of 1965 as amended. This institution is also expected to have doctoral level courses of study in scientific and research areas related to this CRA that can result in the granting of a doctoral degree. The LRO has primary responsibility for articulating and executing the vision for the basic research and maintaining cross-Alliance collaboration and integration. This Member is expected to articulate a vision for the CRA, promote collaboration among Partners, subawardees and the Alliance, and coordinate crosscutting themes with the Alliance. The LRO is required to administer, integrate, and manage the Partners, participate in the research, and promote the transition of research and technologies resulting from the basic research program within the CRA. This includes distribution of Government funding to Partners in accordance with the approved IPP/APP under the agreement. Leadership from the LRO is expected to enhance the potential for transition of the resultant research and technology into both the commercial sector and the DoD.

Partners (Key Subawardees):

ARL envisions a CRA awarded to a Recipient with two Key Subawardees to meet the objectives for this program. However, the number of Key Subawardees is up to the discretion of the offerors. The Key Subawardees, as Partners, will fulfill the goals of this program through intimate involvement in the research program and provision of strategic input concerning the goals and direction of the CRA.

Subawardees:

The Alliance may be augmented with subawardees to conduct specific research projects as necessary and appropriate to meet the goals of the CRA, especially for the conduct of new and innovative research for which they are particularly suited.

Covered Educational Institutions:

The FY10 Department of Defense (DoD) Authorization Act, Public Law 111-84, provides authority for the Secretary of each military department to carry out a program to provide assistance to "covered educational institutions" to assist DoD in defense-related research, development, testing, and evaluation activities. The term "covered educational institution" is defined to mean an **(1)** an institution of higher education eligible for assistance under title III or IV of the Higher Education Act of 1965 (20 U.S.C. 1051 et seq.); or **(2)** an accredited postsecondary minority institution. As defined under title III or IV of the Higher Education Act, "covered educational institution" includes Historically Black Colleges and Universities/Minority-Serving Institutions (HBCU/MSIs).[1]

Accordingly, it is required that covered educational institutions receive 5-10% of the annual funding under the CA. This may be accomplished through one of the following: (a) a covered educational institution submitting the proposal as LRO ; (b) a covered educational institution being included as a Partner or other subawardee in a proposal; or (c) the proposal including a plan for how the LRO will work collaboratively with the Government to identify a covered educational institution for participation in the program.

Federally-Funded Research and Development Centers (FFRDCs) and National Laboratories:

[1] See the definition of a "eligible institution" at 20 U.S.C. 1067q which includes historically Black colleges and universities and other minority-serving institutions.

FFRDCs and National Laboratories may participate as Partners or other subawardees; however, their participation must be within the scope of their charter or sponsorship agreements. Further, FFRDCs and National Laboratories must cost-share an amount equal to the funding to be provided to them under the CA.

2. Cost Sharing or Matching

Except for FFRDCs and National Laboratories, cost sharing is not required to be responsive to the PA. No level of cost sharing is stipulated; however, it is encouraged. During the evaluation of proposals, cost sharing will be evaluated as it relates to the evaluation factors listed in the PA, based on the degree to which the proposed cost sharing enhances the proposal to result in added benefits to the CRA Program. In order for the proposed cost sharing to receive appropriate credit during the evaluation process, the proposal should evidence **a firm commitment** to provide such cost share and also evidence **a process for integrating the cost share into the collaborative research program**.

3. Dun and Bradstreet Universal Numbering System (DUNS) Number and Central Contractor Registration (CCR)

I. *Central Contractor Registration and Universal Identifier Requirements.*

A. *Requirement for recipients.* Unless you are excepted from this requirement under 2 CFR 25.110, you as the recipient must maintain the currency of your information in the Central Contractor Registration (CCR) until you submit the final financial report required under this award or receive the final payment, whichever is later.

B. *Requirement for subrecipients.* If you are authorized to make subawards under this award, you:

1. Must notify potential subrecipients that no entity (*see* definition in paragraph C of this award term) may receive a subaward from you unless the entity has provided its Data Universal Numbering System (DUNS) number to you and is registered in the CCR.
2. May not make a subaward to an entity unless the entity has provided its DUNS number to you and is registered in the Central Contractor Registration.

C. *Definitions.* For purposes of this award term:

1. *Central Contractor Registration (CCR)* means the Federal repository into which an entity must provide information required for the conduct of business as a recipient. Additional information about registration procedures may be found at the CCR Internet site (currently at *http://www.ccr.gov*).
2. *Data Universal Numbering System (DUNS) number* means the nine-digit number established and assigned by Dun and Bradstreet, Inc. (D&B) to uniquely identify business entities. A DUNS number may be obtained from D&B by telephone (currently 866–705–5711) or the Internet (currently at *http://fedgov.dnb.com/webform*).
3. *Entity,* as it is used in this award term, means all of the following, as defined at 2 CFR part 25, subpart C:
   a. A Governmental organization, which is a State, local government, or Indian tribe;
   b. A foreign public entity;
   c. A domestic or foreign nonprofit organization;
   d. A domestic or foreign for-profit organization; and
   e. A Federal agency, but only as a subrecipient under an award or subaward to a non-Federal entity.
4. *Subaward:*

a. This term means a legal instrument to provide support for the performance of any portion of the substantive project or program for which you received this award and that you as the recipient award to an eligible subrecipient.
b. The term does not include your procurement of property and services needed to carry out the project or program (for further explanation, *see* Sec. __.210 of the attachment to OMB Circular A–133, ‘‘Audits of States, Local Governments, and Non-Profit Organizations’’).
c. A subaward may be provided through any legal agreement, including an agreement that you consider a contract.

5. *Subrecipient* means an entity that:
   a. Receives a subaward from you under this award; and
   b. Is accountable to you for the use of the Federal funds provided by the subaward.

D. APPLICATION AND SUBMISSION INFORMATION

1. Address to Request Application Package -

Proposals shall be submitted electronically through the www.grants.gov portal. Proposals sent by fax or email will not be considered.

Registration Requirements for www.grants.gov: There are several one-time actions that an offeror must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider, and register with Grants.gov). See www.grants.gov/GetRegistered to begin this process. Use the Grants.gov Organization Registration Checklist at www.grants.gov/Applicants/get-registered.isp to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants, who are not registered with CCR and Grants.gov, should allow at least 21 days to complete these requirements. It is suggested that the process be started as soon as possible.

Questions: Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov.

2. Content and Form of Application Information

Application forms and instructions will be available at Grants.gov. To access these materials, go to http://www.grants.gov, select "Apply for Grants", and then select "Download an Application Package." Enter the funding opportunity number, W911NF-11-R-0002.

NOTE: Compatible versions of Adobe Reader are currently 8.1.1 and 8.1.2. You will be asked to specify your Operating System (examples: Windows, Mac) and Version (examples: XP, Vista, 10.4.9) be sure to specify Adobe Reader Version 8.1.2 to get the compatible version to apply for grants on Grants.gov. Click here to download version 8.1.2 from Adobe Website: http://www.adobe.com/products/acrobat/readstep2_allversions.htm.

Offerors must complete the mandatory forms and any optional forms (e.g., SF-LLL Disclosure of Lobbying Activities) in accordance with the instructions on the forms and the additional instructions below. The required fields should be completed in accordance with the “pop-up”

instructions on the forms. To activate the instructions, turn on the "Help Mode" (icon with the pointer and question mark at the top of the form). Files that are attached to the forms must be in Adobe Portable Document Form (PDF) unless otherwise specified in this announcement.

The following formatting rules apply for the file attachments:

- Paper size when printed – 8.5 x 11 inch paper
- Margins – 1 inch
- Spacing – single
- Font – No smaller than Times New Roman, 10 point

Form: SF 424 (R&R) (Mandatory) – Complete this form first to populate data in other forms. Authorized Organization Representative (AOR) usernames and passwords serve as "electronic signatures" when your organization submits applications through Grants.gov. By using the SF 424 (R&R), offerors are providing the certification required by 32 CFR Part 28 regarding lobbying.

Form: Research & Related Other Project Information - Complete questions 1 through 6 and attach files.

Project Summary/Abstract (Field 7 on the form) - The Project Summary should be a brief abstract that summarizes the content of the Basic research of the proposal. The project summary must not exceed 5 pages. Pages in excess of the page limit may be removed for the evaluation of the proposal.

Project Narrative (Field 8 on the form) - Chapters and Numbers of pages – Field 8 is to contain the chapters set forth below and may not exceed the stipulated page counts for those chapters. Pages in excess of the page limits may be removed for the evaluation of the proposal.

- Chapter 1 - **Research Program**. The pages included in Chapter 1 shall be numbered. Offerors are advised that Chapter 1 **shall not exceed 60 pages**, utilizing one side of the page.
- Chapter 2 – **Collaboration Plan**. The pages included in Chapter 2 shall be numbered. Offerors are advised that Chapter 2 of the proposal **shall not exceed 40 pages**, utilizing one side of the page.

- Chapter 3 - **Program Management** . The pages included in Chapter 3 shall be numbered. Offerors are advised that Chapter 3 of the proposal **shall not exceed 20 pages**, utilizing one side of the page.
- Chapter 4 – **Biographical Sketches** - Biographical sketches shall be limited to two (2) pages per individual, with no limitation on the number of individuals.

Bibliography and References Cited (Field 9 on the form) - Attach a listing of applicable publications cited in above sections.

Facilities and Other Resources (Field 10 on the form) - The offeror is to include a listing of facilities and other resources available to support the proposal. Any Government resources necessary for performance are to be clearly identified. Attach this information at Field 10.

Equipment (Field 11 on the form) - The offeror is to include a listing of equipment available to support the proposal. Any Government equipment necessary for performance is to be clearly identified. Attach this information at Field 11.

Other Attachments (Field 12 on the form) are as follows:

1. Attached the completed Proposal Cover Sheet. (See PART D.6 below.)

2. Attached the completed certifications. (See PART F.2 below.)

3. Attach any exceptions or conditions to the Model Cooperative Agreement (See CRA website for this document.)

4. Attach the Cost Proposal. **The Cost Proposal must include 2 separate budgets for the first five years of performance: one for the Core Research Program and one for the Enhanced Research Program. The Cost Proposal for the Core Research Program MUST address all requirements for the Core Research Program. It is acknowledged that the Cost Proposal for the Enhanced Research Program is expected to be in lesser detail as the specifics of such activities will not be known until performance. The cost proposal for the Enhanced Research Program is to be based on the general discussion of research that might be pursued with Enhanced Program funding. (The Recipient will be requested to provide a complete cost proposal for the optional five-year period of performance as part of the evaluation to be completed prior to making the decision concerning this optional period.)** The cost portion of the proposal shall contain cost estimates sufficiently detailed for meaningful evaluation. For budget purposes, assume a performance start date of 1 February 2012**.** The proposed amounts shall not exceed the funding ceilings identified for the Core Research Program of this PA. For all proposals, the elements of the budget should include:

   - Direct Labor - Individual labor category or person, with associated labor hours and unburdened direct labor rates.
   - Indirect Costs - Fringe benefits, overhead, G&A, etc. (must show base amount and rate). Justify.
   - Travel - Number of trips, destination, duration, etc. Justify and include basis for costs.
   - Subaward - A cost proposal, as detailed as the offeror's cost proposal, will be required to be submitted by each proposed subrecipient.

   - (NOTE: Cost proposals must evidence the required level of subaward costs for each year. A detailed cost proposal is not required for subawardees after FY13; however, offerors are to provide some basis for the subawardee costs proposed after FY13.)

   - Consultant - Provide consultant agreement or other document that verifies the proposed loaded daily/hourly rate. Include a description of the nature of and the need for any consultant's participation. Provide budget justification.

   - Materials - Specifically itemized with costs or estimated costs. An explanation of any estimating factors, including their derivation and application, shall be provided. Include a brief description of the offeror's procurement method to be used (competition, engineering estimate, market survey, etc.). Justify. Other Directs Costs - Particularly any proposed items of equipment or facilities. Equipment and facilities generally must be furnished by the recipient (justifications must be provided when Government funding for such items is sought). Include a brief description of the offeror's procurement method to be

used (competition, engineering estimate, market survey, etc.). Justify.

All entities including Subawardees are to provide detailed information on all cost elements included in their proposed budgets as part of the proposal submission process. 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 Grants.gov. In such a case, a separate submission can be made directly to the Government. Such a submission MUST include the PA Number, i.e. W911NF-11-R-0002, and the name of the LRO associated with the proposal on the mailing envelope submitted to the following address:

U.S. Army RDECOM Contracting Center
RTP Contracting Division
ATTN: W911NF-11-R-0002/WERTLEY-ROTENBERRY
4300 S. Miami Blvd.
Durham, NC 27703

NOTE: All such separate submissions must arrive NLT than the due date and time for the proposal submission through Grants.gov to be considered. Further, for all such submissions summary cost information must be provided to the LRO for the Grants.gov submission that is sufficient in detail for the Government to use in the evaluation of the cost proposal for cost realism, and can be clearly mapped to the proprietary rate information submitted directly to the Government.

SF-LLL - Disclosure of Lobbying Activities

If applicable, attach a complete SF- LLL at Field 11 of the R&R Other Project Information form. Applicability: If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the grant/collaborative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying."

3. Submission Dates and Times

Proposals are due by 3:00 pm (Local North Carolina, USA time), 07 March 2011.

After a proposal is submitted through Grants.gov, the Authorized Organization Representative (AOR) will receive a series of three e-mails. It is extremely important that the AOR watch for and save each of the e-mails. Offerors will know that the proposal has been properly received when the AOR receives e-mail Number 3. Retain the Submission Receipt Number (e-mail Number 1) to track a submission. The three e-mails are:

Number 1 – The AOR will receive a confirmation page upon completing the submission to Grants.gov. This confirmation page is a record of the time and date stamp for the submission.

Number 2 – The AOR will receive an email indicating that the proposal has been validated by Grants.gov within a few hours of submission. (This means that all of the required fields have been completed.)

Number 3 – The third notice is an acknowledgment of receipt in email from Grants.gov. The email is sent to the AOR for the institution. The email notes that the proposal has been received and provides the assigned tracking number. THE PROPOSAL IS NOT CONSIDERED PROPERLY RECEIVED UNTIL THE AOR RECEIVES EMAIL #3.

4. Intergovernmental Review - Not applicable

5. Funding Restrictions - See PART II.A above.

6. Other Submission Requirements

The following Proposal Cover Sheet is required to be submitted by each offeror:

PROPOSAL COVER SHEET

1. Information concerning the LRO (points of contact (POC)):

Research POC: _____

Phone No.: _____

Fax No.: _____

Email Address _____

Business POC _____

Phone No.: _____

Fax No.: _____

Email Address: _____

2. List the names and relationships of all organizations included in the proposal:

LRO _____

Subawardee(s) _____

Covered Educational Institution(s) _____

3. Provide a point of contact for each organization included in the Cost Proposal. These individuals may be contacted for questions concerning the Cost Proposal:

Organization: _____

POC: _____

Phone No.: _____

Email Address _____

4. Signature of one person for the proposed LRO authorized to submit a proposal and bind that organization:

Organization Name: _____

Signature: _____

Type Name/Title: _____

Date (Proposal): _____

E. APPLICATION REVIEW INFORMATION

1. Proposal Evaluation Criteria

The following represents the evaluation criteria for this PA:

Factor 1: Scientific and Technical Merit of Five Multiscale Modeling Research Core Elements: The scientific and technical merit will be evaluated with regard to each of the five Multiscale Modeling Research Core Elements The five subfactors are : a) Modeling and Simulation, b) Bridging the Scales, c) Multiscale Modeling Metrics, d) Validation and Verification, and e) Processing and Synthesis. Each of the five Multiscale Modeling Research Core Elements will be assessed with regard to its overall scientific merit, creativity, innovation, and likelihood of substantially advancing the current state-of-the-art for each of the three Electronic Materials Research Areas. The proposed scientific approach must be feasible and complete. Task descriptions and associated scientific elements provided must be complete and in a logical sequence with all proposed deliverables clearly defined such that a final outcome can be expected that addresses the five Multiscale Modeling Research Core Elements for each of the three Electronic Materials Research Areas of the MSME CRA. Task descriptions and associated scientific elements must also be designed so as to achieve the two, five, and ten year goals of the MSME CRA. The proposals must clearly identify major scientific opportunities to be pursued and the associated risks, and clearly define feasible mitigation strategies to address those risks. The proposals must clearly explain in substantial detail the specific scientific plans that will be employed to meet or exceed each program goal, and provide ample justification as to why the approaches are likely to substantially advance the underlying science.

Factor 2. Overall Materials by Design Strategy: Implementation and integration of the Materials by Design concept across disciplines and appropriate participants in the five Multiscale Modeling Research Core Elements will be evaluated by considering:

- The strategy for executing the materials by design concept to design materials and predict properties among appropriate team members
- The integration of the five Multiscale Modeling Research Core Elements into the overarching concept of materials by design (Are all the Multiscale Modeling Research Core Elements constructively working to the strategic goal?)
- The strategy for incorporating the three Electronic Materials Research Areas
- The validation techniques and metrics proposed to verify the strategy is working

Factor 3: Experience and Qualifications of Scientific Staff and Quality of Research Facilities: The qualifications, publications, capabilities, availability, and experience of the offeror's research personnel, their relevant past accomplishments in multiscale multidisciplinary research, and their ability to achieve the proposed research objectives will

be evaluated. The type, nature, quality, relevance, availability, access and SoA of the research facilities and equipment will be evaluated. This factor will assess:

- The research team stature, qualifications and track record of SoA research:
  - scientific/engineering stature of research personnel as indicated by publications, awards, professional society status and activities, etc.
  - Relevance of experience/stature relative to the five Multiscale Modeling Research Core Elements
  - Relevance of experience across all materials classes to be considered
  - Degree to which research staff's time-commitment to the CRA is meaningful and substantial
- The breadth, depth and degree of SoA of the proposed modeling and simulation assets

Factor 4: Collaboration Plans with ARL: Evaluation of this factor will focus on the proposed collaboration plans for the CRA in accordance with the collaboration requirements set forth in the PA. The proposed collaboration plans should be feasible and are expected to create a cost-effective collaborative program with ARL researchers that promotes collaboration on a regular, physical and continuing basis (i.e., in an open lab environment). Creative strategies for sharing of resources (labor and equipment), organization of personnel exchange programs, identification of personnel with shared interests and/or complementary skills and strategies for facilitating transition of research results and new technologies to the Army will be assessed.

Factor 5: Relevance to the ARL missions and programs: Evaluation of this factor will concentrate on the long term relevance of proposed research to the ARL/SEDD mission. The effectiveness of the proposed research to address scientific challenges and research barriers currently facing Army materials and manufacturing research will be evaluated. The proposed scientific approach is expected to make significant contributions to in-house ARL research activities and simultaneously exhibit high relevance to the national technology base. The mission of ARL is to provide the underpinning science, technology, and analysis that enable Army full-spectrum operations. The mission of the ARL Sensors and Electron Device Directorate is to conduct innovative research in the areas of sensors, electron devices and power and energy to provide the Army with affordable enabling technology in advanced electro-optical technologies; flexible displays; advanced RF technologies; electronic materials and devices; autonomous sensing; micro autonomous technologies; hybrid electric vehicle, platform, and pulse power; directed energy; and micro, Soldier, and portable power.

Factor 6: Program Management and Execution. Evaluation of this factor will assess the adequacy of the overall management (business) plan, internal team structures and composition with respect to achieving the research goals of the program. The offeror's plan for program execution will be assessed to include the offeror's ability to develop and follow a program plan in accordance with Army obligation and disbursement goals. Items that will be evaluated under this factor include:

- The quality of the overall management plan, oversight strategy and the proposed metrics for success
- The qualification, leadership skills and experience of the Program Manager and the Lead Research Organization (LRO)
- The plan for the time commitment of the CRA leadership should be substantial and consistent with the scope of the program to ensure successful execution of the program

- Degree to which the CRA leadership are preeminent and accomplished scientists/engineers in their own right and have the requisite management experience required
- If management of similar efforts is cited as evidence of management and execution capabilities, the information should include identification of the Government sponsors, a description of the scope of the program, and an assessment of performance
- The plans for involvement of covered educational institution(s)
- The plans for the Enhanced Research Program

Factor 7: Cost. While this area will not be weighted, 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 shall 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 and G&A, etc.

Relative Importance of the Evaluation Factors: The combined weight of Factor (1) and Factor (2) is greater than the combined weight of the remaining factors (Factors (3) through (6)). Within Factor (1), the subfactors are listed in descending order of importance with subfactors (a), (b), and (c) approximately equal and subfactors (d) and (e) approximately equal. The combined weight of all subfactors of Factor (1) is greater than the weight of Factor (2). The weight of Factor (2) is greater than the weight of any of the individual subfactors of Factor (1). For Factors (3) through (6), Factor (6) has the greatest weight. Factors (3), (4) and (5) are in descending order of importance, with Factors (3) and (4) approximately equal. Factor (7) is not weighted.

2. Review and Selection Process

All information necessary for the review and evaluation of a proposal must be contained within the proposal. No other material will be provided to those evaluating proposals. An initial review of the proposals will be conducted to ensure compliance with the requirements of this PA. Failure to comply with the requirements of the PA may result in a proposal receiving no further consideration for award.

Proposals that are in compliance with the requirements of the PA will be evaluated in accordance with the evaluation factors described above using an adjectival and color rating system. A Source Selection Evaluation Board (SSEB) will evaluate the proposals. The SSEB consisting of qualified groups of scientists, managers, and cost specialists will evaluate each proposal and provide the results of that evaluation to the Source Selection Authority (SSA). The SSA will make decisions concerning the competitive range and award selection.

If a competitive range is established and negotiation discussions are held, ARL anticipates such discussions will be held at a site identified by each offeror. This site is expected but not required to be the location of the LRO. Any such meeting will be coordinated with the offeror at the appropriate time.

Award will be based on an integrated assessment of each offeror's ability to satisfy the PA requirements. The Government reserves the right to award without discussions. If discussions are held, offerors in the competitive range will be invited to submit Final Proposal Revisions, that will be

evaluated using the same evaluation procedures as were used in the initial proposals. The Government will make award to the offeror, conforming to the PA, that offers the best value to the Government, cost and other factors considered. Further, award may be made to other than the offeror who offers the lowest cost proposal. ARL reserves the right not to make an award should no acceptable offer be submitted.

3. Recipient Qualification - See **PART II.C.1** above.

4. Anticipated Announcement And Awards Dates - See **PART I** above**.**

F. AWARD ADMINISTRATION INFORMATION

1. Award Notices

Should your proposal be selected for award, you will be contacted telephonically or via email by the Grants Officer or his/her representative. At that time the offeror will be asked to execute the Cooperative Agreement. Award is not made until the CA is signed by both the successful offeror and the Grants Officer.

2. Administrative And National Policy Requirements

Offerors must comply with National Policy Requirements Matrix Appendix "C" found at http://www.nsf.gov/bfa/dias/policy/rtc/appc.pdf.

3. Reporting

Reporting requirements for the CA are contained in the Model CA which will be posted to the CRA website.

G. AGENCY CONTACTS

Questions or comments concerning this PA will be posted through the MSME CRA website at www.arl.army.mil/CRAMSME. Questions and comments should be concise and to the point. In addition, the relevant part and paragraph of the PA should be referenced. Responses to questions received will be posted to the MSME CRA website for the benefit of all interested parties. Should an offeror have questions they believe are of a proprietary nature, the offeror must clearly state so in the question when posed. Answers to questions of a proprietary nature will be provided via email directly to the poser of the question. A location on the website will be provided for potential offerors to post their availability for teaming with others.