DEVCOM Army Research Laboratory

In partnership with

The Intelligence Advanced Research Projects Activity (IARPA)

BROAD AGENCY ANNOUNCEMENT FOR

Entangled Logical Qubits (ELQ)

W911NF-23-S-0004

Issued by:

US Army Contracting Command–Aberdeen Proving Ground

Research Triangle Park Division

P.O. Box 12211

Research Triangle Park, NC 27709-2211

I. OVERVIEW OF THE FUNDING OPPORTUNITY

Required Overview Content

Federal Agency Name(s)
U.S. Army Research Office

Issuing Acquisition Office
U.S. Army Contracting Command-Aberdeen Proving Ground, Research Triangle Park Division (ACC-APG-RTP Division)

Funding Opportunity Title
Entangled Logical Qubits (ELQ)

Announcement Type
Initial Announcement

Research Opportunity Number: W911NF-23-S-0004

Catalog of Federal Domestic Assistance (CFDA) Number
12.431 – Basic Scientific Research

Response Dates
Proposals: 4:00 PM Eastern Time on: **21 March 2023**
See Section II. D. 4 for additional information.

Additional Overview Information

This Broad Agency Announcement (BAA), which sets forth research areas of interest to the Army Research Laboratory-Army Research Office (ARL-ARO) and the Intelligence Advanced Research Projects Activity (IARPA), is issued under paragraph 6.102(d)(2) of the Federal Acquisition Regulation (FAR), and 10 USC 4001 which provides for the competitive selection of basic research proposals. Proposals submitted in response to this BAA and selected for award are considered to be the result of full and open competition and in full compliance with the provision of Public Law 98-369, "The Competition in Contracting Act of 1984" and subsequent amendments.

The Department of Defense (DoD) agencies involved in this Program reserve the right to select for award either all, some, or none of the proposals submitted in response to this announcement. The participating DoD agencies will provide no funding for direct reimbursement of proposal development costs. Technical and cost proposals (or any other material) submitted in response to this BAA will not be returned. It is the policy of participating DoD agencies to treat all proposals as sensitive, competitive information and to disclose their contents only for the purposes of evaluation.

This BAA makes frequent use of the terms "Offeror" and "Performer". They are not interchangeable. An Offeror is an entity who submits a proposal. Statements referring to Offeror

or Offerors are therefore directed at those preparing a proposal. A Performer designates an entity engaged in Program work and provides here a useful point of view when describing expected activities of the Program. Statements referring to Performer(s) are thus intended to inform Offerors about the kinds and pace of work those engaged in the Program would be expected to undertake; they are not intended to set or imply requirements for the proposal.

II. DETAILED INFORMATION ABOUT THE FUNDING OPPORTUNITY

A.1 Funding Opportunity Description

A.1.1 Introduction and Background

Quantum computing (QC) has the potential to transcend classical limits of computing in applications of interest to the Intelligence Community (IC) and the DoD. Qubits—the indivisible units or "bits" of quantum information within a quantum computer—exhibit quantum coherence[1] and entanglement[2,3] properties but are also subject to noise and couplings to the environment, all of which weaken coherence and lead to the loss of quantum information during computation and thus produce computational errors. Fortunately, qubits may be organized into computational units called logical qubits (LQs) that work to preserve quantum information and coherence by detecting errors within their boundaries, identifying corrections, and admitting repairs, all while maintaining fault tolerance.[1,2] Theoretical and experimental advances in quantum error correction[2] (QEC) have led to several demonstrations of fault-tolerant (FT) logical qubits in recent years across different hardware platforms. A further step towards universal, fault-tolerant quantum computing[2] (UFTQC), however, comes by engaging separate LQs into entanglement, all while sustaining coherence and the protections of fault tolerance.

Entangled Logical Qubits (ELQ) is a four-year foundational research program directed at generating high-fidelity entanglement between two error-corrected LQs in a fully FT manner, and utilizing it to achieve logical state teleportation with high success. These accomplishments will lay the cornerstone for realizing the full potential of QC and make a profound advance on the path to UFTQC. The program is divided into four (4) phases, outlined in Table 1, Table 2, and Table 4, and described in detail in Section A.3. Proposals covering all four Phases are being solicited under this BAA; proposals covering fewer may not receive full consideration.

Broadly, ELQ seeks to develop and demonstrate schemes that preserve FT properties throughout an operational sequence that incorporates LQ entanglement. Importantly, the schemes must also exhibit modularity, where the entangled ensemble is built from, and separable into, decoupled, independently-operable LQs residing on the same physical platform. Modularity is also reinforced by the Program's structure, with LQs being established separately during the first through third years of the Program before proceeding with entangling operations. We define modularity in Section A.2.1.2 and Box A in connection with architectural requirements.

While limited theoretical work exists, FT logical entanglement from the engagement of separate LQs is a frontier topic providing new ground for theory and practice to meet, cooperate, and evolve toward an objective critical to UFTQC. Achieving high-fidelity, maximally-entangled logical states, as evidenced, for example, by teleportation[3] success rates of 95% or higher, is an ambitious

[1] See "Overview of the Status of the Quantum Science and Technology and Recommendations for the DoD," IDA Document D-10709, S. A. Wolf, Project Leader, June 2019.

[2] See "Quantum Computing: Progress and Prospects," E. Grumbling and M. Horowitz, eds., National Academies Press, Washington DC (2019).

[3] See "Quantum Information Science: An Emerging Field of Interdisciplinary Research and Education in Science and Engineering," Report of the NSF Workshop, 28-29 October 1999, Arlington VA, NSF Publication NSF-00-101.

yet attainable target in consideration of continuing advances in state-of-the-art performance of quantum hardware and related controls. The challenges—spanning developments of hardware, software, QEC protocols, benchmarking protocols—awaiting this deeper excursion into QC will be considerable. Successful teams will be interdisciplinary, adept at working at the interfaces between the disciplines involved, and capable of executing ground-breaking results.

A.1.2 Outline of Scientific Scope and Resources

As described in Section A.1.1, ELQ aims to produce an entangled logical state in a scheme that comprises the necessary ingredients of modular UFTQC, and employ it to achieve logical state teleportation. A system capable of such a demonstration requires two logical qubits, accompanied potentially by other ancillary (auxiliary) physical or logical qubits, and the exercise of code blocks that can detect, correct, and thus suppress errors. ELQ requires logical qubit encodings and FT processes that maintain the ability to identify and correct one (1) arbitrary single Pauli error (Pauli-X, Y, or Z)[3] per LQ during the process of entanglement from its initial steps to its conclusion. This corresponds to a distance-3 encoding of each logical qubit involved in the logical entangling operation. Such a system in total will likely comprise and engage tens of qubits in highly-entangled ensembles. Running a system of this scale for ELQ program objectives would require, at minimum, high-fidelity control of physical qubits and gates throughout the quantum layer and its operational sequences. Noise and errors must be suppressed to low levels consistently across the system and for long periods, to achieve a system performance that is sufficiently reliable and stable for ELQ objectives. Under the heading of benchmarking, innovative methods for testing many-qubit assemblies and their manipulations will also be needed to verify the performance at each increasingly complex stage of the system leading to full integration. While these expectations pose several pressing challenges, recent technical work[4] has nonetheless proven capable of demonstrating the operation and benchmarking of several tens of qubits in algorithms with relatively deep circuits.

A.1.3 New Methods to Generate a Logical Entangled State in a Modular System

The ELQ program merges the challenges of QEC, FT design, and elemental control of many physical qubits into a definite operation involving LQ entanglement under the constraints of a modular approach. For context, ELQ looks ahead to the circumstance of a UFTQC machine, where LQs would operate independently and engage at intervals in entangling operations. ELQ's constraints and operations are thus chosen to approximate this general condition while provoking the architectural choices and challenges necessary for maintaining LQs as modular entities. With this in mind, the proposed effort should investigate logical entangling schemes and underlying error correction protocols that suit the proposed hardware platform, with due consideration of the relevant sets of errors affecting the fidelity of the maximally-entangled logical state and other required operations. Central to ELQ's objectives is the development of low-overhead architectures culminating in logical entanglement as part of and consistent with the demonstration of logical-state teleportation at a high success rate. Offerors should propose a logical entanglement protocol for the chosen hardware platform and describe plans and resources to refine what may be a preliminary protocol into an optimal, resource-efficient architecture during the Program.

[4] See references in "Accelerating Progress Towards Practical Quantum Advantage: A National Science Foundation Project Scoping Workshop," arXiv: 2210.14757 (2022).

A.1.4 Technical-Approach Considerations

As previously described, ELQ requires that the logical encoding protocol allows for FT quantum error correction of an arbitrary single-Pauli error, and that fault-tolerance is preserved throughout the logical entanglement protocol. ELQ Performers are also expected to advance the frontiers of quantum benchmarks and push the limits of simulations of quantum systems by developing advanced, efficient tools and methods. These ambitious technical and theoretical objectives must then manifest through hardware demonstrations. Offerors should thus consider approaches with high feasibility of success. In this regard, resource-efficient approaches with low experimental overhead, cost, and complexity are generally desirable. The choice of technology (type of qubit) to be used for encoding the logical qubit is open to the discretion of the Offeror, but the chosen technology must have already demonstrated multi-qubit operations and control (deterministic state preparation, single-qubit and entangling gates, and readout). Overall, Offerors should consider how the proposed technology will meet program goals and operate against program milestones and metrics.

A.1.5 Out of Scope

Out of scope approaches for ELQ are:

- Non-fault-tolerant schemes;
- Schemes not capable of performing repeated QEC cycles;
- Foundational research, e.g., development of nascent qubit technologies;
- Quantum-computing approaches not based on quantum-gate operations,[1] e.g., quantum annealing;
- Simulation and optimization using quantum-hardware platforms;
- Quantum systems not directly intended or involved for quantum-information processing, e.g., quantum communications and quantum sensing.

A.2 Program Structure

A.2.1 Research Thrusts

The scientific program approach for developing ELQ theory and experiments is divided into the three complementary and interconnected Research Thrusts—Architecture, Hardware, and Benchmarking—presented in Figure 1 and described later in this section. The Research Thrusts cover the research effort that vector toward demonstrating a complete ELQ experiment operating ultimately at high-performance levels of logical entanglement and logical teleportation. Proposals must address all three (3) Thrusts, with awareness of their research relationships. Novel solutions in one area, for example, should be evaluated for impacts to others. At the same time, a Thrust should be developed with sufficient flexibility to accommodate prospective research advancements in other Research Thrusts.

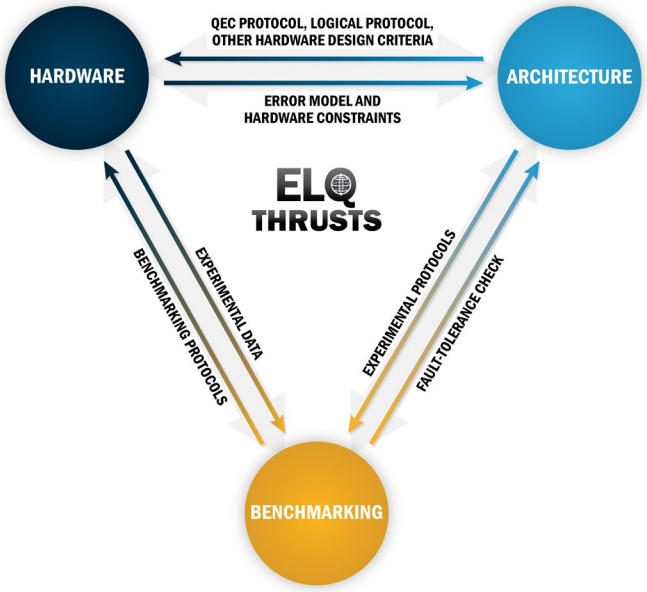


Figure 1. ELQ Program Thrusts. Hardware and Architecture Thrusts are highly linked: Architectural arrangements and dictates are bounded by Hardware constraints, which inspire Architecture to return customized, optimal protocols to the Hardware. Architectural design and Hardware execution are evaluated independently and mutually through the Benchmarking Thrust, results from which are fed back to the designs, requirements, and assumptions set by the Architecture and Hardware Thrusts.

Offerors should develop each Research Thrust and the relationships among them into a coordinated, coherent research plan that will meet the Program's timeline and objectives. The plan should be examined for challenges; solutions should be proposed for each. Given the research nature of ELQ, it would not be unexpected to see a team's ultimately successful approach differ from what was proposed. Thus, in addition to providing a technical plan, Offerors should explain the fundamentals composing each Thrust and guiding their interplay, their systematic approaches to problems, and how they have organized a foundation for success in the face of unmet or unexpected challenges. For example, an Offeror's general strategy for optimizing hardware, architecture, and benchmarking tools, as might be exercised throughout the Program, should be explained fully, whether expressed through the proposed plan or detailed separately.

A.2.1.1 Hardware Research Thrust

The Hardware Research Thrust includes all hardware components and operational requirements needed to achieve ELQ goals through the proposed experiments.

Proposed efforts should:

A.2.1.1.i Articulate the quantum layer including the necessary number of physical qubits and the qubit-coupling schemes. Evaluate coherence-time requirements. Describe approaches for improving coherence times to the levels necessary for ELQ's goals.

A.2.1.1.ii Propose approaches for controlling physical qubits and designing/optimizing gates to the level of precision and fidelity needed for the demonstration and study of logical entanglement, and the attainment of ELQ's goals.

A.2.1.1.iii Estimate the classical-processing requirements for the QEC decoder, including maximum tolerable latencies. Compare requirements with candidate processor(s).

A.2.1.1.iv Estimate classical control modules' latency requirements for achieving real-time error correction in the modular approach to an error-corrected logical entangling operation that preserves fault-tolerance and sufficient coherence throughout the circuit.

A.2.1.1.v Describe experimental apparatus that needs to be procured, assembled, or built to support proposed experiments on the quantum layer optimally, including potential custom-designed apparatus. This includes apparatus needed to maintain the quantum layer under operational physical conditions (temperature, pressure, electromagnetic field profile, etc.).

A.2.1.1.vi Describe other infrastructure supporting optimal operation of and/or communication with the quantum layer, such as components and modules needed for high-fidelity qubit readout.

A.2.1.2 Architecture Research Thrust

The Architecture Research Thrust focuses on FT error correction protocols and the design of the logical entangling operation in a resource-efficient, modular scheme.

Proposed efforts should articulate:

A.2.1.2.i A preliminary logical encoding scheme (QEC code) and describe strategies for developing optimal codes and their resource-efficient implementation using the native gate set.

A.2.1.2.ii A preliminary logical entangling protocol suitable for the demonstration of the logical entangling operation with the chosen hardware platform. The logical encoding, its prospective optimal implementation, and decomposition to native gates should be capable of uniquely identifying and correcting one (1) arbitrary single-qubit Pauli error per LQ.

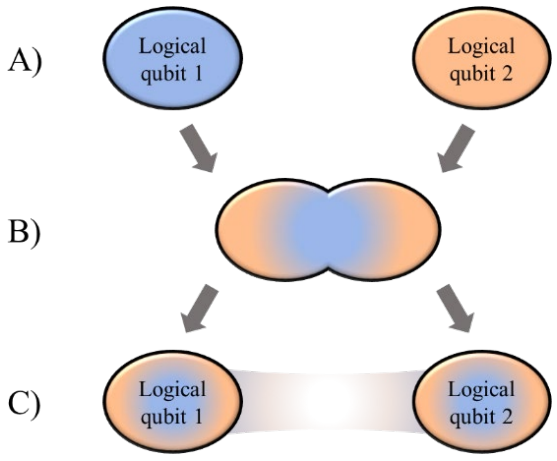
A.2.1.2.iii A scheme(s) compatible with the fault-tolerant implementation of the preliminary circuit and its components: the logical encoding circuit, single logical qubit gates, the logical entangling operation, the syndrome extraction circuit, and syndrome readout must all retain fault-tolerant properties. ELQ's fault-tolerance requirement refers to the protocol design only. Reaching error threshold, breaking even with constituent physical qubits, or demonstration of error suppression are not requirements of the Program. System performance will be benchmarked against Program Metrics and Performer-designed Waypoints (see Section A.2.3).

A.2.1.2.iv The extent to which real-time error correction, as opposed to correction strictly through post processing, will be necessary to preserve fault-tolerance.

A.2.1.2.v A preliminary modular architecture for the logical entangling system. ELQ's modular architecture corresponds to the "divisibility" of the involved LQs. A divisible architecture concept, in principle or in effect, is a preliminary basis of physical layout and actions for replication into a pattern of a larger system that preserves independent operations down to the unit modules while providing connections between them. A module may be seen as an LQ inclusive of resources and actions up to the interface for entanglement with another LQ, though other boundaries or descriptions may apply. In connection with the proposed architecture, it should be noted that the prescription, development, and demonstration of an engineered module ready for assembly into a larger system is not expected for ELQ nor is it necessarily desirable given the significant demand it would likely place on research resources. Rather, the proposed architecture may concentrate on exposing the essential building blocks for a divisible scheme, for expression and combination through hardware into demonstrations meeting ELQ's objectives. Box A illustrates and fully captures ELQ's modularity requirements. Modularity, divisibility, extensibility, or scalability of hardware or architecture beyond this description is not a requirement of the ELQ program. Offerors should describe how their solutions to modularity are feasible and consonant with the objectives and pace of the Program, e.g., by citing precedent for the required elementary operations and/or building blocks.

Box A – ELQ's modularity research goals

ELQ seeks an entangling scheme that is formed from and divisible into constituent, independent, and independently-controlled LQs. Conceptually, and as illustrated below, each logical qubit must be, in principle, operable by physical-qubit control parameters that do not depend on the physical presence of the other logical qubit(s) before and after the logical entangling operation. Additionally, the physical qubit gate parameters used to control each LQ before the logical entangling operation must be identical to those used after the logical entangling operation.



Steps A, B, and C represent ELQ's modular architecture at, respectively, stages immediately before, during, and immediately after a logical entangling operation. Outside of B, each LQ is operable by gate parameters that are, in principle, independent of the status, activity, or even absence of the other LQ (or any other LQs or auxiliary resources the scheme may include). The physical qubit gate parameters used to control each LQ at C are those used at A.

A.2.1.3 Benchmarking Research Thrust

The Benchmarking Research Thrust focuses on the challenges of assessing the performance of a quantum system up to the scale of the full proposed system.

Proposed efforts should articulate:

A.2.1.3.i Calibration protocols to tune-up the experimental system for optimal performance.

A.2.1.3.ii Known protocols for characterizing and quantifying the relevant errors in the system, including the subset of noise processes most relevant to the performance of the logical entangling system.

A.2.1.3.iii Approaches for "Waypoint" design, which is the application of benchmarking protocols for verifying and setting rulers of intermediate performance as the proposed experiments grow in complexity from components to a fully integrated system (please refer to Section 9 and Table 3 for the definition and use of Waypoints). For purposes of the proposal, in addition to describing approaches for Waypoint design, Offerors may outline example Waypoints for one or more Phases, such as benchmarks for the building blocks of a logical qubit and/or the logical entangling system.

Computational simulations of building blocks and the full system are anticipated to be integral to executing each of the Research Thrusts and exploiting their connections. Offerors should thus take stock of and identify the resources and support that may be needed for running especially computationally-intensive simulations, along with identifying any other specialized computational resource(s) relevant to the proposed approach.

A.2.2 Goals and Connection with Metrics

The Program's goals are manifold and include seeing performers succeed in the development and execution of logical-entanglement operations in accord with criteria for QEC, fault tolerance, and modularity described in the foregoing sections. Metrics, associated with these goals, provide progressive scientific evidence of the success of proposed approaches throughout the research effort, supply gauges for learning strengths and weaknesses, and provide opportunities to craft solutions. The Government will use the Program Metrics (see Figure 2) in its overall assessment of the effectiveness of proposed solutions in advancing the state of the art and to determine whether scientific progress against these Metrics is showing satisfactory achievement. For Offerors and

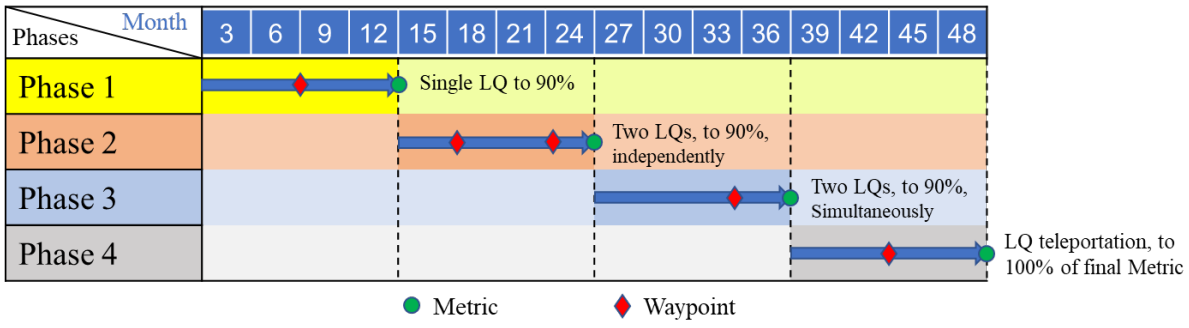


Figure 2. ELQ timeline, showing Waypoint(s) and a concluding Metric for the experimental activities of each Phase. Phases are described in Section 4b. Details on Waypoints and Metrics are provided in Section A.2.3.

Performers alike, Metrics are intended to give focus and provide scientific direction to a research approach while permitting flexibility, creativity, and innovation in an offered or developed scientific approach or solution.

A.2.3 Program Milestones, Deliverables, Metrics, and Waypoints

Program Milestones, Deliverables, and Metrics form a major body of evaluation material; the Government will use them to determine whether research progress is satisfactory and continued funding warranted for the scientific approach. Waypoints, set by the Performer, add to and improve the Government's evaluation of research progress by providing evidence that the technical and programmatic risks associated with the proposed approach are being addressed and knowledge and understanding are being advanced. For the purposes of this BAA, Milestones, Deliverables, Metrics, and Waypoints have the following definitions:

- Program Milestones (Table 1): Sequence of Government-identified actions or achievements tied to specific times of the Research Program and thus marking scientific progress (e.g., demonstration of a component by a particular date).
- Deliverables (Table 1): Government-specified technical reports delivered at specified times for Government review and assessment during the Program execution (e.g., submission of a progress report). Deliverables are expected to be provided regardless of the choice of technology or approach as they are important evidentiary documentation of the research and provide the Government with appropriate snapshots of the research progress.
- Metrics (Table 2): A quantitative, program-wide, and technology-agnostic measure of experimental system performance (e.g., fidelity of a particular operation). Protocols for extracting Metrics from experiments will be provided by IARPA to match program goals. All Metrics are expected to be relevant and applicable regardless of the choice of technology or approach. Metrics may be modified based on lessons learned during the research efforts. Metrics changes would be expected to come by discussions between IARPA, ARO, and any affected Performer(s). The Metrics represent the scientific parameters expected to be achieved to advance knowledge and capabilities in the area of fault-tolerant quantum computing.
- Waypoints (see Table 3 for template): Performer-identified performance targets, tied to a specific time in the Program execution. Generally, Waypoints compose a ruler of progress for the performance of logical qubit operations and other building blocks of the logical entangling system. Each Performer will supply their own system- and approach-specific Waypoints. Waypoints must be clear, well-defined, and logically connected to Performer and/or Government decisions. Quantitative (Metric-like) Waypoints, e.g., Performer-designed benchmarks to assess building blocks of the logical entangling system, are highly preferred as they can be utilized as quantitative measures of progress. Additional non-quantitative (Milestone-like) Waypoints are desirable. Progress against these Waypoints will be reviewed throughout the Program to assess whether course corrections are needed to ensure Research Program success. Each Phase must have one or more interim Waypoints that lend assessment(s) toward the metrics of that Phase. In their proposals, Offerors are welcome to incorporate Waypoints, as could help clarify the development of their proposed solution and the associated timeline.

Table 1: Program Deliverables and Milestones for all Phases

Due by (Month)	Description
Phase 1, Goal: Architecture and protocol design. Building-block demonstrations	
3	• **Deliverable** Deliver Progress Report: Detailed error model, estimated system requirements, detailed optimal 1-LQ encoding (as extensible to LQ entanglement), and estimated 1-LQ performance.
9	• **Deliverable** Deliver Updated Progress Report: Detailed architecture and optimal protocols consistent with ELQ's fault-tolerance/quantum-error correction/modularity requirements, Waypoints for gauging experimental progress (and points of theoretical confirmation) through the architectural development.
12	• **Deliverable** Deliver Architecture Report: Comprehensively treat all topics under the Architecture Thrust (Section A.2.1.2). Complete architecture and detailed evaluation/requirements/schedule for reaching Program Metrics. Propose sub-system Waypoints capable of estimating key error classes and providing a predictive basis for full-system performance. Benchmark classical controls against architectural requirements. • **Milestone** Demonstrate all building blocks of a single LQ compatible with ELQ's modularity requirements. • **Milestone** Demonstrate single LQ operation.
Phase 2, Goal: Design, production, and demonstration of advanced building blocks	
21	• **Milestone** Demonstrate all building blocks necessary for LQ entanglement and demonstrations. • **Deliverable** Deliver Updated Progress Report: Architectural reassessment, revision, and update. Include any additional resources and/or requirements.
24	• **Milestone** Integrate into a single system all building blocks necessary for LQ entanglement and demonstrations. • **Milestone** Demonstrate operation of the two LQs independently in the same system.
Phase 3, Goal: Integration of the full logical entangling system	
30	• **Milestone** Fully characterize the complete LQ-entanglement system, inclusive of two LQs and any extra qubit resources. • **Deliverable** Deliver Updated Progress Report: Updated architecture, with reassessments and/or revisions to resources, requirements, and the physical-error model.
36	• **Milestone** Demonstrate simultaneous operation (uncoupled, unentangled) of the two logical qubits in the complete system.

Phase 4, Goal: Logical entangled state generation and teleportation	
42	• **Milestone** Demonstrate and benchmark preliminary logical entangled state using two different benchmarking protocols: logical teleportation, and a to-be-determined protocol.
48	• **Milestone** Demonstrate and benchmark final, high-fidelity logical entangled state using two different benchmarking protocols: logical teleportation, and a to-be-determined protocol. • **Deliverable** Deliver Final Report.

The final Metric of the Program is to demonstrate teleportation of cardinal logical states with an average success rate of 0.95 or higher. Box B gives general rules for the teleportation procedure. Performers can use the logical teleportation protocols of their choice provided that the protocol complies with ELQ requirements for fault-tolerance, quantum error correction, and modularity (see Box B for details). IARPA and the T&E team(s) will work together to design an additional Program-wide benchmark to estimate the fidelity of the logical entangled state. Using this benchmark, Performers will demonstrate logical entangled state fidelity corresponding to the above-mentioned final Metric (see Table 2 for details).

Box B – ELQ's final Metric: logical teleportation protocol

A) The source logical qubit (SLQ) is prepared in one of the cardinal logical states ($|\psi\rangle_L$), drawn, for example, from $\{|0\rangle, |1\rangle, |+\rangle, |-\rangle\}$. The destination logical qubit (DLQ) is prepared according to the Performer's teleportation protocol.

B) Logical entanglement is mediated by auxiliary (ancillary) physical or logical qubits such that no joint quantum operation occurs directly between the original SLQ and DLQ resources. Approaches should be prepared to run full, FT, QEC cycles before and after the FT logical entangling operation.

C) At the final step of the protocol, $|\psi\rangle_L$ is teleported to the DLQ, which is measured in the appropriate logical basis. The above procedure is repeated many (≥1,000) times for each cardinal logical state, producing the averaged and reported success rate.

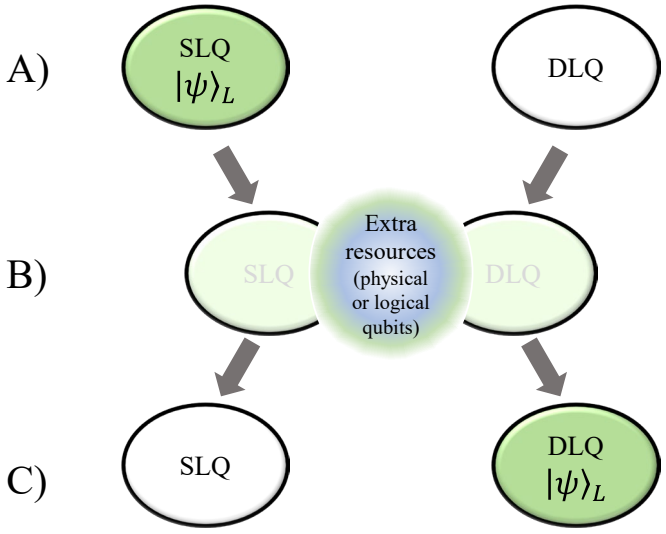


Table 2: Program Metrics for all Phases.

Phase	Due by (Month)	Metric Figure-of-Merit	Percent of Architectural Target*
Phase 1	12	Single LQ performance† inclusive of QEC relative to architectural target	**90%**
Phase 2	18	Performance of classical control instrumentations relative to architectural target (latency, memory, and other relevant specifications)	**80%**
	24	Performance of each LQ relative to architectural target in a system of 2 LQs (independent LQ operation, no ancillary / auxiliary qubits required)	**90%**
Phase 3	33	Performance of classical control instrumentations relative to architectural target (latency, memory, and other relevant specifications)	**100%**
	36	Performance of each LQ, operated simultaneously, relative to architectural target in a complete system for the final Metric.	**90%**
Phase 4	42	Average teleportation success rate for cardinal logical states compared to final Metric	**90%**
		Fidelity of logical entangled state relative to architectural target (by TBD protocol)	**90%**
	48	Average teleportation success rate for cardinal logical states compared to final Metric	**100%**
		Fidelity of logical entangled state relative to architectural target (by TBD protocol)	**100%**

*Architectural targets are performance values for protocols and components consistent with the final Metric and determined from comprehensive simulations.

† LQ performance refers to the average "survivability" of logical cardinal states following logical encoding, one round of QEC, and logical qubit readout.

Table 3: Template for Waypoint schedule

Phase	Month	Waypoint Description	Associated Deliverable, Milestone, or Metric	Comments

A.2.4 Government Furnished Information, Capability, or Equipment (GFI/GFC/GFE)

An Offeror may request a unique Government facility, specialized equipment, or technical service that would be useful to a proposed solution to the ELQ BAA. In such instances, the unique Government capacity would be provisioned to the Offeror so long as the arrangement is permitted by ARO and IARPA, and no funds from the award to the Offeror flow to the Government entity providing the unique capacity. The use of these capabilities is not required and is at the sole discretion of the Offeror. See also Section C.3 and Appendix A.

A.2.5 Testing & Evaluation

ELQ will utilize independent Government test-and-evaluation (T&E) team(s) to assist in evaluating progress, assessing technical reports, and developing and vetting benchmarks.

The test and evaluation process includes five primary activities:

1) evaluation of the Architecture Report and Progress Reports (inclusive of architecture updates, see Table 1);
2) evaluation of Metrics reported by the Performers;
3) evaluation and verification of Waypoints;
4) assessment of Performers' physically-motivated error models and Performers' capabilities in modeling and simulating noise processes relevant to their specific systems; and
5) the design, refinement, and verification of Program-wide benchmarks to estimate the fidelity of a maximally-entangled logical qubit state.

T&E team(s) are an impartial Government resource. No advice or consultation services will be extended to Performers by the T&E team(s) in connection with the above activities or for other aspects of the Program.

A.3 Detailed Program Account

Offerors are to propose strategy(ies) that thread, link, and coordinate the three Research Thrusts (Section A.2.1) through all four Phases, as outlined in Section A.2.3. Anticipated research activities during the four Phases and links to Research Thrusts are described below and provide a guiding template for Proposers to appropriately structure and iterate their research plans. Each phase must be planned as a program funding option.

A.3.1 Phase 1 (12 months)

Phase 1 is focused on architectural plans, protocols, and elementary building blocks of a logical entangling system. The Architecture Report due at the end of the phase is expected to be a considerable body of theoretical research that includes the detailed design of a modular, fault-tolerant entangling operation that achieves Program goals, backed by extensive simulations. On the experimental front, Performers build and demonstrate a single, moderately high-performance logical qubit that is consistent with their architectural plans. Activities are categorized by Research Thrust (Figure 1), to set the stage for their continuing arc and interplay for the rest of the Program.

For the Architecture Thrust, Performers are expected to study a FT encoding scheme for a single logical qubit suitable for their proposed hardware platform. The encoding scheme is then shown to be extensible to logical entanglement and compatible with ELQ's modularity goals. A detailed physically-motivated error model is expected to be central to simulate the logical qubit's performance and estimate the corresponding research system requirements. Performers may utilize feedback provided in response to Architecture Research Thrust reports to refine their architecture plans. New findings of resource efficiency, for example, could figure importantly in ensuring success.

For the Benchmarking Research Thrust, based also on simulations, the Performer—as the subject matter expert of their hardware platform—sets intermediate targets (Waypoints; Figure 2 and Section A.2.3) for gauging the experimental progress in each Phase and proposes sub-system benchmarks capable of estimating key error classes and providing a predictive basis for full-system performance. Performer Waypoints will be examined by ARO, IARPA, and ELQ's T&E team.

Finally, the Performer sets out the complete architecture accompanied by detailed benchmarks, system requirements, and a plan for reaching Program metrics. As part of that plan, Performers would be expected to outline strategies for bringing physical qubits and gates to the performance levels required of the high-fidelity logical entangled state signified by ELQ's final Metric.

For the Hardware Research Thrust, Performers, for their approaches, demonstrate logical-qubit building blocks and then integrate them into a logical-qubit demonstration against ELQ's Phase 1 benchmarking protocol and numerical metric for LQ performance. The protocol would be provided during the first half of Phase-1. The Metric for the LQ is to benchmark at a level of 90% of the value it would have to meet to achieve ELQ's final Metric based on the Architecture Report, forming an architectural target. Throughout this and the subsequent Phases, Performers are expected to identify and characterize the types of relevant noise mechanisms and their corresponding magnitudes in the system, for comparison with expectations and, more generally, for feedback to and assessment of the architectural plan/assumptions and the approaches to benchmarking.

A.3.2 Phase 2 (12 months)

Phase 2 focuses on the design, fabrication, and demonstration of advanced building blocks necessary to demonstrate logical entanglement. These building blocks, with specifications identified in the Architectural Report, would be demonstrated and verified in Phase 2. This includes at least two logical qubits with all the required apparatus, infrastructure, and other supporting hardware. In the final goal of this Phase, the Performer should demonstrate independent operation of both LQs and show that each LQ has a performance at or better than 90% relative to the architectural target. Integrating additional auxiliary/ancillary physical or logical qubits beyond two independently operating logical qubits is not required in this Phase. Based on the performance and diagnostic tests of the integrated system, the Performer reassesses, revises, and updates architectural plans and specifies any additional resources and/or requirements, as appropriate.

A.3.3 Phase 3 (12 months)

Phase 3 focuses on integration of the full logical-entangling experimental system by fully integrating all the building blocks, including any auxiliary (ancillary) logical or physical qubits required by ELQ's final Metric (See Box B), and all the necessary hardware, apparatus, and infrastructure. The final goal of Phase 3 is to demonstrate simultaneous but independent (unentangled and decoupled) operation of two LQs that would be used in the demonstration of ELQ's final Metric. By the end of Phase 3, the performance of the decoupled 2-LQ system should reach or exceed 90% of the architectural target.

A.3.4 Phase 4 (12 months)

Phase 4 focuses on the use and demonstration of the high-fidelity logical entangled state. Automated, customized, and potentially novel calibration routines would likely be essential tools for tuning-up the full system for optimal performance. The final Metric of Phase 4 and the Program is to exercise high-fidelity logical entanglement in a teleportation success rate of 0.95 or higher.[5] Separately, the fidelity of the maximally-entangled logical state would be benchmarked using an additional protocol provided by ARO, IARPA, and the T&E Teams, where the target fidelity of the logical entangled state corresponds to the above-mentioned final Metric.

A.3.5 Information and Reports for the Test & Evaluation activity

Performers should be prepared to use a reporting template, provided at the beginning of T&E activities in each Phase, to submit the status of relevant Milestones, Deliverables, Metrics, and Waypoints (Section A.2.3; Table 1, Table 2, and Table 3). This template will be developed by the T&E team(s) in coordination with ARO, IARPA, and Performers. Performers should also plan to provide to T&E team(s) their supporting data or information related to meeting (or making progress toward) Milestones, Metrics, and Waypoints. This includes (but is not limited to) specifications of the hardware, software, protocols, infrastructure, apparatus, and qubit control systems pertaining to the ELQ Program. In their provided material, Performers, where appropriate, are encouraged to add and detail their approach(es) to validation, e.g., of chosen error models. ARO and IARPA typically share Performer Deliverables with the T&E team.

A.4 Program Calendar: Meetings, Site Visits, Deliverables, and T&E Reviews

ELQ will use the timelines for Deliverables, Milestones, and Metrics outlined in Table 1 and Table 2 to monitor Program progress and maintain its four-phase, 48-month schedule. Table 4 sets these along with periods of T&E review to a calendar format. Program Meetings and Site Visits at regular intervals afford additional opportunities for Performer Teams to convey research progress and challenges to the ELQ management team. These Meetings and Site Visits are, in effect, deliverables; Table 4 provides their expected schedule. While the advancement to a next Phase will be subject to Government considerations including Program progress and available funding, Offerors should plan for the full 48-month effort.

[5] Teleportation success rate is reported as the average over the teleportation of cardinal logical states (see Section A.2.3 and Box B).

Table 4: Program calendar

Phase 1*	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Kick-Off Meeting												
PI Meeting												
Site visit												
Progress Report/Update												
Architecture Report												
T&E Report Review												
T&E Data Review												
Phase 2	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
Technical Exchange Meeting (TEM)												
PI Meeting												
Site visit												
Progress Report/Update												
T&E Report Review												
T&E Data Review												
Phase 3	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
TEM												
PI Meeting												
Site visits												
Progress Report/Update												
T&E Report Review												
T&E Data Review												
Phase 4	M37	M38	M39	M40	M41	M42	M43	M44	M45	M46	M47	M48
TEM												
PI Meeting												
Site visits												
T&E Data Review												
Final Report												

*Technical and financial status reports are due monthly throughout the Program (not shown on calendar).

A.5 Meetings, Travel Requirements, and Publications

Performers are expected to assume responsibility for administration of their project and to comply with contractual and Program requirements for reporting, including attendance at Program meetings and availability for site visits.

All Performer teams are expected to attend Program Meetings, to include key personnel from prime and subcontractor organizations. The ELQ Program intends to hold a Kick-off Meeting in the first month of the Program followed by semi-annual meetings thereafter, alternating between PI Meetings and Technical Exchange Meetings (see Table 4 for the expected schedule). The specific dates and locations of these meetings will be set by the Government, but for planning

purposes Offerors may assume that the meetings will be held in the Washington, D.C., metropolitan area. ARO and IARPA may opt to hold the meeting virtually for logistical and/or health and safety reasons.

PI Meetings will typically be two to three (2 to 3) days in duration with a primary purpose of communicating Program progress and the statuses of Milestones, Deliverables, Metrics, Waypoints and research plans to ARO, IARPA, and USG stakeholders. The meetings will focus on technical aspects of the Program and facilitate technical exchanges, interactions, and sharing among the various Program participants. Program speakers will be expected to present the technical status and progress of their projects to participants and invited guests. Poster sessions typically accompany (in-person) PI meetings to encourage project team members, including students and postdocs, to present and discuss their accomplishments.

Technical Exchange Meetings (TEMs) will typically span (3) days and include external researchers and speakers for their additional technical insights and perspectives. The TEMs otherwise cover Program status and progress toward ELQ goals in the manner of PI Meetings. As with PI meetings, poster sessions at TEMs are typically held to expand the opportunity for Project team members and individual researchers to present their work.

All information presented openly to Program participants at Program Meetings should be non-proprietary. Discussions or presentations involving proprietary material should be withheld for the closed, sidebar sessions with the Government team that are typically part of these meetings. Program meetings often present opportunities for scheduling other closed sessions, for instance of a Performer team with the ELQ Program Manager or with the T&E Team(s).

Site visits by the Government team will generally take place during the life of the Program as outlined in Table 4. These visits will occur at the Performer's facility. Technical presentations and discussions (covering status and progress, insights and successes, and difficulties and recourses) along with technology demonstrations and laboratory tours are among the usual components of site visits. ARO and IARPA reserve the right to conduct additional site visits on an as-needed basis, reduce the number of site visits, or switch to a virtual format for logistical and/or health and safety reasons.

Remote update meetings may be scheduled monthly where Performers present the previous month's research activities, review open action items, discuss upcoming research, and identify any concerns or issues which could affect the Program. Such meetings may come at the request of the Performer and may be established at any time during the Program by ARO and IARPA. Biweekly (twice monthly) update meetings may also be arranged if either the Performer or ARO and IARPA thought the increased frequency would be beneficial.

Performers would be encouraged to publish their research in academic journals and/or present their research at appropriate research conferences. Accordingly, Offerors may include and plan for these professional expectations in their proposals. From Performers, ARO and IARPA will expect courtesy copies of posters and presentations associated with ELQ research at least ten (10) days in advance of the submission deadline. ARO and IARPA will also expect to receive copies of manuscripts, preprints, and final publications. All published material shall include the proper acknowledgement

to ARO and IARPA, including contract information. ARO and IARPA will provide appropriate language to use for acknowledgement.

B. Federal Award Information

Anticipated awards will be made in the form of procurement contracts, grants, cooperative agreements, or other transactions and are subject to the availability of appropriations. Funding for the second year and beyond will be contingent upon satisfactory performance and the availability of funds.

The Army Contracting Command-Aberdeen Proving Ground, Research Triangle Park (ACC-APG RTP) Division has the authority to award a variety of instruments on behalf of Army Research Laboratory-Army Research Office (ARL-ARO). The ACC-APG RTP Division reserves the right to use the type of instrument most appropriate for the effort proposed. Applicants should familiarize themselves with these instrument types and the applicable regulations before submitting a proposal. Following are brief descriptions of the possible award instruments.

1. Procurement Contract

A legal instrument, consistent with 31 U.S.C. 6303, which reflects a relationship between the Federal Government and a State Government, a local government, or other entity/contractor when the principal purpose of the instrument is to acquire property or services for the direct benefit or use of the Federal Government.

Contracts are primary governed by the following regulations:

a. Federal Acquisition Regulation (FAR) https://www.acquisition.gov/browse/index/far
b. Defense Federal Acquisition Regulation Supplement (DFARS) https://www.federalregister.gov/defense-federal-acquisition-regulation-supplement-dfars-
c. Army Federal Acquisition Regulation Supplement (AFARS) https://www.acquisition.gov/afars

2. Grant

A legal instrument that, consistent with 31 U.S.C. 6304, is used to enter into a relationship:

a. The principal purpose of which is to transfer a thing of value to the recipient to carry out a public purpose of support or stimulation authorized by a law or the United States, rather than to acquire property or services for the DoD's direct benefit or use.
b. In which substantial involvement is not expected between the DoD and the recipient when carrying out the activity contemplated by the grant.
c. No fee or profit is allowed.

3. Cooperative Agreement

A legal instrument which, consistent with 31 U.S.C. 6305, is used to enter into the same kind of relationship as a grant (see definition "grant"), except that substantial involvement is expected between the DoD and the recipient when carrying out the activity contemplated by the cooperative agreement. The term does not include "cooperative research and development agreements" as defined in 15 U.S.C. 3710a. No fee or profit is allowed.

4. Technology Investment Agreement

An assistance instrument as described in 32 CFR Part 37. A TIA may be a cooperative agreement or an Other Transaction for Research under 10 U.S.C. 4021 both with provisions tailored for involving commercial firms or research involving commercial application. To the maximum extent practicable, TIAs shall provide for a 50/50 cost share between the Government and the applicant. No fee or profit is allowed on TIAs.

5. Other Transaction for Research

A legal instrument, consistent with 10 U.S.C. 4021, which may be used for basic, applied, and advanced research projects. The research covered under this instrument cannot be duplicative of research being conducted under an existing DoD program. To the maximum extent practicable, OTs for research are to provide for a 50/50 cost share between the Government and the applicant. An applicant's cost share may take the form of cash, independent research and development (IR&D), foregone intellectual property rights, equipment, access to unique facilities, and/or other means. Due to the extent of cost share, and the fact that an OT for research does not qualify as a "funding agreement" as defined at 37 CFR 401.2(a), the intellectual property provisions of this instrument can be negotiated to provide expanded protection to an applicant's intellectual property. No fee or profit is allowed on OTs for research. Please refer to the Office of the Under Secretary of Defense for Acquisition and Sustainment Other Transaction Guide version 1.0 dated November 2018 for additional information. This document, along with additional other transaction agreement (OTA) resources, may be accessed at the following link: https://www.acq.osd.mil/asda/dpc/cp/policy/other-policy-areas.html

6. Other Transaction for Prototype or Production.

A legal instrument, consistent with 10 U.S.C. 4022, which provides DoD the flexibility necessary to adopt and incorporate business practices that reflect commercial industry standards and best practices into its award instruments. OTs for prototypes or production are not FAR-based procurement contracts, grants, cooperative agreements, or OTs for Research. OTs for prototypes or production have specific applications and conditions for use (see Appendix C of the Other Transactions Guide linked below). The effort covered under an OT cannot be duplicative of effort being conducted under an existing DoD program. Follow-on production contracts and/or an OT may be awarded to a Prototype Other Transaction Awardee, if applicable. Please refer to the Office of the Under Secretary of Defense for Acquisition and Sustainment Other Transaction Guide version 1.0 dated November 2018 for additional information. This document, along with other OTA resources, may be accessed at the following link: https://www.acq.osd.mil/asda/dpc/cp/policy/other-policy-areas.html

7. Grants and cooperative agreements for Institutions of Higher Education, nonprofit organizations, foreign organizations, and foreign public entities

Legal instruments which are primary governed by the following:

a. Federal statutes.

b. Federal regulations.
c. 2 CFR part 200, as modified and supplemented by DoD's interim Implementation found in 2 CFR part 1103.
d. 32 CFR Parts 21, 22, 26, and 28.
e. DoD R&D General Terms and Conditions.
f. ACC-APG-RTP Division Assistance, Research General Terms and Conditions dated December 2020, hereinafter referred to as "Agency Specific Requirements".
g. Award-specific terms and conditions.

8. Grants and cooperative agreements for for-profit and nonprofit organizations exempted from Subpart E—cost principles of part 200

Legal instruments which are primary governed by the following:

a. Federal statutes.
b. Federal regulations.
c. 2 CFR Part 200 Subparts A through E for administrative requirements for grants and cooperative agreements awarded to for-profit organizations.
d. 32 CFR § 34.16, Audits for grants and cooperative agreements awarded to for-profit organizations.
e. 32 CFR Part 34 – Administrative Requirements for Grants and Agreements with For
f. 32 CFR Parts 21, 22, 26, and 28.
g. DoD Research and Development General Terms and Conditions
h. Agency-specific Research Terms and Conditions

9. OTs for Research

Legal instruments which are primarily governed by the following:

1. Federal statutes
2. Federal regulations
3. 32 CFR Part 37 – Technology Investment Agreements
4. DoD Research and Development General Terms and Conditions
5. Agency-specific Research Terms and Conditions
6. Office of Secretary of Defense implementation guidance titled Other Transactions (OT) Guide for Research Projects (November 2018, Version 1)

10. OTs for Prototypes or Production

Legal instruments which are primarily governed by the following:

1. Federal statutes
2. Office of Secretary of Defense implementation guidance titled Other Transactions (OT) Guide for Prototype Projects (November 2018, Version 1)

Copies of OMB regulations may be obtained from:

Executive Office of the President
Publications Service
New Executive Office Building
725 17th Street, N.W., Room 2200
Washington, DC 20503
Telephone: (202) 395-7332
FAX Requests: (202) 395-9068
https://www.whitehouse.gov/omb/information-for-agencies/circulars/

The following websites may be accessed to obtain an electronic copy of the governing regulations and terms and conditions:

a. FAR, DFARS, and AFARS: https://www.acquisition.gov
b. Code of Federal Regulations (CFR): http://www.ecfr.gov
c. DoD Research and Development General Terms and Conditions: https://www.onr.navy.mil/en/work-with-us/manage-your-award/manage-grant-award/grants-terms-conditions
d. An electronic copy of the DoDGARs may be found at http://www.ecfr.gov (Title 32: National Defense, Subchapter C – DoD Grant and Agreement Regulations.

C. Eligibility Information

1. Eligible Applicants:

Eligible applicants under this BAA include Institutions of Higher Education (foreign and domestic), nonprofit organizations, and for-profit concerns (large and small businesses). Proposals are encouraged from Historically Black Colleges and Universities (as determined by the Secretary of Education to meet requirements of Title III of the Higher Education Act of 1965, as amended (20 U.S.C. §1061)) and from Minority Institutions defined as institutions "whose enrollment of a single minority or a combination of minorities exceeds 50 percent of the total enrollment." [20 U.S.C. § 1067k(3) and 10 U.S.C. § 2362]. However, no funds are specifically allocated for HBCU/MI participation.

2. Cost Sharing or Matching:

There is no requirement for cost sharing, matching, or cost participation to be eligible for award under this BAA and cost sharing and matching is not an evaluation factor used under this BAA.

3. Other Government Agencies (OGAs), Federally Funded Research and Development Centers (FFRDCs), and University Affiliated Research Centers (UARCs):

Other Government Agencies (OGAs), Federally Funded Research and Development Centers (FFRDCs), and University Affiliated Research Centers (UARCs) are not eligible for funding under this BAA. However, an Offeror may find these types of entities to provide a unique Government facility, specialized equipment, or technical service that would be useful to a proposed solution to the ELQ BAA. In such instances, the unique Government capacity would be provisioned to the Offeror so long as the arrangement is permitted by ARO and IARPA,

and no funds from the award to the Offeror flow to the Government entity providing the unique capacity. The use of these capabilities is not required and is at the sole discretion of the Offeror. See also Appendix A.

D. Application and Submission Information

1. Address to View Broad Agency Announcement

This BAA may be accessed from the following:

1) Grants.gov (https://www.grants.gov/)
2) SAM (https://www.SAM.gov)
3) ARL website (https://www.arl.army.mil/business/broad-agency-announcements/)

Amendments, if any, to this BAA will be posted to these websites when they occur. Interested parties are encouraged to periodically check these websites for updates and amendments.

The following information is for those wishing to respond to the BAA:

2. Content and Form of Application Submission

a. General Information

A proposal submitted under this BAA must address unclassified fundamental research. Proposal submissions will be protected from unauthorized disclosure in accordance with applicable laws and DoD regulations. Applicants are expected to appropriately mark each page of their submission that contains proprietary information. The participating DoD agencies will provide no funding for direct reimbursement of proposal development costs. Technical and cost proposals (or any other material) submitted in response to this BAA will not be returned. It is the policy of participating DoD agencies to treat all proposals as sensitive, competitive information and to disclose their contents only for the purposes of evaluation.

Post-Employment Conflict of Interest: There are certain post-employment restrictions on former federal officers and employees, including special government employees (Section 207 of Title 18, U.S.C.). If an applicant believes a conflict of interest may exist, the situation should be discussed with Point of Contact listed in Section G: Agency Contacts, who will then coordinate with appropriate ARO/ARL legal personnel prior to having applicant expend time and effort in preparing a white paper or proposal.

Statement of Disclosure Preference: Please complete ARO Form 52 or 52A stating your preference for release of information contained in your white paper or proposal. Copies of these forms are available at https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/ NOTE: A white paper or proposal may be handled for administrative purposes by support contractors. These support contractors are prohibited from competing on BAA proposals and are bound by appropriate non-disclosure requirements.

Equipment: Normally, title to equipment or other tangible property purchased with

Government funds vests with nonprofit institutions of higher education or with nonprofit research organizations if vesting will facilitate scientific research performed for the Government. For profit organizations are expected to possess the necessary plant and equipment to conduct the proposed research. Deviations may be made on a case-by-case basis to allow commercial organizations to purchase equipment, but disposition instructions must be followed.

b. Preparing an Application

This format applies to all proposals submitted via email and via Grants.gov. Offerors' proposals should show the location of each section of the proposal, as well as major subdivisions of the project description.

COVER PAGE ARO FORM 51: for Contract proposals submitted by email. The Form SF 424 (R&R) is for all proposals submitted through Grants.gov (Assistance Instruments must submit through Grants.gov):

1. A Cover Page is required. Proposals will not be processed without either: (1) a signed Cover Page, ARO Form 51, or (2) an SF 424 R & R Form.

2. Should the project be carried out at a branch campus or other component of the submitting organization, that branch campus or component should be identified in the space provided (Block 11 on the ARO Form 51 and Block 12 on the SF424 R&R).

3. The title of the proposed project should be brief, scientifically representative, intelligible to a scientifically literate reader, and suitable for use in the public domain.

4. The proposed duration for which support is requested should be consistent with the program duration of forty-eight months.

5. Specification of a desired starting date for the project is important and helpful however, requested effective dates cannot be guaranteed.

6. To evaluate compliance with Title IX of the Education Amendments of 1972 {20 U.S.C. A§ 1681 Et. Seq.), the Department of Defense is collecting certain demographic and career information to be able to assess the success rates of women who are proposed for key roles in applications in STEM disciplines. To enable this assessment, each application must include the following forms completed as indicated.

   Research and Related Senior/Key Person Profile (Expanded) form:

   The Degree Type and Degree Year fields on the Research and Related Senior/Key Person Profile (Expanded) form will be used by DoD as the source for career information. In addition to the required fields on the form, applicants must complete these two fields for all individuals that are identified as having the project role of

PD/PI or Co-PD/PI on the form. Additional senior/key persons can be added by selecting the "Next Person" button.

Research and Related Personal Data form:

This form will be used by DoD as the source of demographic information, such as gender, race, ethnicity, and disability information for the Project Director/Principal Investigator and all other persons identified as Co-Project Director(s)/Co-Principal Investigator(s). Each application must include this form with the name fields of the Project Director/Principal Investigator and any Co-Project Director(s)/Co-Principal Investigator(s) completed; however, provision of the demographic information in the form is voluntary. If completing the form for multiple individuals, each Co-Project Director/Co-Principal Investigator can be added by selecting the "Next Person" button. The demographic information, if provided, will be used for statistical purposes only and will not be made available to merit reviewers. Applicants who do not wish to provide some or all of the information should check or select the "Do not wish to provide" option.

7. Pursuant to 31 U.S.C. 7701, as amended by the Debt Collection Improvement Act of 1996 [Section 31001(I)(1), Public Law 104-134], federal agencies shall obtain each awardees' Taxpayer Identification Number (TIN). This number may be the Employer Identification Number for a business or non-profit entity or the Social Security Number for an individual. The TIN is being obtained for purposes of collecting and reporting on any delinquent amounts that may arise out of an awardees' relationship with the Government.

8. Offerors shall provide their organization's Unique Entity Identifier (formerly DUNS). This number is a nine-digit number assigned by Dun and Bradstreet Information Services. See Section II.D.3 of this BAA for requirements pertaining to the Unique Entity Identifier.

9. Offerors shall provide their assigned Commercial and Government Entity (CAGE) Code. The CAGE Code is a 5-character code assigned and maintained by the Defense Logistics Service Center (DLSC) to identify a commercial plant or establishment.

TABLE OF CONTENTS: Use the following Format for the Proposal Table of Contents, Forms are available at https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/

SECTION	PAGE NUMBER
Table of Contents	A-1
Statement of Disclosure Preference (Form 52 or 52A)	B-1
Research & Related Other Project Information	B-2
Project Abstract	C-1
Project Description (Technical Proposal)	D-1 - D-□
Biographical Sketch	E-1 - E-□
Bibliography	F-1 - F-□

Current and Pending Support	G-1 - G-□
Facilities, Equipment, and Other Resources	H-1 - H-□
Proposal Budget	I-1 - I-□
Contract Facilities Capital Cost of Money (DD Form 1861)	J-1
Appendices	K-□
List Appendix Items: _____	

This format applies to proposals submitted via email and via Grants.gov. Offerors' proposals should show the location of each section of the proposal, as well as major subdivisions of the project description.

STATEMENT OF DISCLOSURE PREFERENCE (FORM 52 OR 52A): Complete and sign ARO Form 52 (Industrial Contractors) or ARO Form 52A (Educational and Nonprofit Organizations), form can be found at the following website: https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/

RESEARCH AND RELATED Other Project Information: The form entitled "Research and Related Other Project Information" found at the following website: https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/, shall be completed and signed by all organizations.

PROJECT ABSTRACT:

1. The Project Abstract shall be completed on the form entitled "Publicly Releasable Abstract" found at the following website: https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/

2. Unless otherwise instructed in this BAA, the Project Abstract shall include a concise statement of work and basic approaches to be used in the proposed effort. The abstract should include a statement of scientific objectives, methods to be employed, and the significance of the proposed effort to the advancement of knowledge.

3. The abstract should be no longer than one (1) page (maximum 4,000 characters).

4. The project abstract shall be marked by the applicant as publicly releasable. By submission of the project abstract, the applicant confirms that the abstract is releasable to the public. For a proposal that results in a grant award, the project abstract will be posted to a searchable website available to the general public to meet the requirements of Title VII (General Provisions), Section 8123, of the Department of Defense Appropriations Act, 2015. (Division C of the Consolidated and Further Continuing Appropriations Act, Public Law 113-235) The website address is https://dodgrantawards.dtic.mil/grants

TECHNICAL PROPOSAL (PROJECT DESCRIPTION): The technical portion of the proposal shall be no longer than 25 pages including tables and figures, single spaced text, size 12 Times New Roman font with one inch page margins, and shall contain the following:

1. Technical Approach: Introduce the problem to be addressed, survey related work, identify key obstacles, and outline the proposed solution that address the program goals and metrics described in A2.2. Proposals should clearly address the expected key challenges and proposed methods to overcome these difficulties taking into consideration the current state of field. The proposed approach shall include: Initial estimation of the performance metrics provided in section A.2.2 Goals and Connection with Metrics.

2. Project Schedule, Milestones, and Deliverables: Program milestones are described in A.2.3. Program schedule and deliverables are described in A.3. In addition, Offerors should set aggressive yearly quantitative milestones that define their proposed path toward the end-of-the-program goals.

3. Management Approach: A discussion of the overall approach to the management of this effort, including brief discussions of: required facilities; relationships with any subawardees and with other organizations; availability of personnel; and planning, scheduling, and control procedures. A brief description of your organization, including if the offeror has extensive government contracting experience. If this information has been previously provided to the ARL/ARO, the information need not be provided again. A statement setting forth this condition should be made.

4. The names of other federal, state, local agencies, or other parties receiving the proposal and/or funding the proposed effort. If none, so state. Concurrent or later submission of the proposal to other organizations will not prejudice its review by the ARL/ARO if we are kept informed of the situation.

5. A statement regarding possible impact, if any, of the proposed effort on the environment considering as a minimum its effect upon water, atmosphere, natural resources, human resources, and any other values.

6. The Offeror shall provide a statement regarding the use of Class I and Class II ozone-depleting substances. Ozone-depleting substances mean any substance designated as Class I by EPA, including but not limited chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform and any substance designated as Class II by EPA, including but not limited to hydrochlorofluorocarbons. See 40 C.F.R. Part 82 for detailed information. If Class I or II substances are to be utilized, a list shall be provided as part of the offeror's proposal. If none, so state.

7. The type of additional support, if any, requested (e.g., facilities, equipment, and materials). Government Furnished Information or Equipment (GFI/GFE) available to all offerors is described in A.2.4.

<u>BIOGRAPHICAL SKETCHES:</u>

1. This Section shall contain the biographical sketches for senior and key personnel only.

a. Primary Principal Investigator: The "Primary" PI provides a single or initial point of communication between the sponsoring agency(s) and the awardee organization(s) about scientific matters. If not otherwise designated, the first PI listed will serve as the "Primary" PI. This individual can be changed with approval of the agency. The sponsoring agency(s) does not infer any additional scientific stature to this role among collaborating investigators.

b. Co-Principal Investigators: The individual(s) a research organization designates as having an appropriate level of authority and responsibility for the proper conduct of the research and submission of required reports to the agency. When an organization designates more than one PI, it identifies them as individuals who share the authority and responsibility for leading and directing the research, intellectually and logistically. The sponsoring agency(s) does not infer any distinction among multiple PIs.

c. Key personnel: The individual(s) a research organization designates as having a high level of technical expertise in the topics proposed to be researched and who will both play an active role in the research and supervise the work of more junior personnel on a daily basis.

2. The following information is required:

a. Relevant experience and employment history including a description of any prior Federal employment within one year preceding the date of proposal submission.

b. List of up to five (5) publications most closely related to the proposed project and up to five (5) other significant publications, including those being printed. Patents, copyrights, or software systems developed may be substituted for publications.

c. List of persons, other than those cited in the publications list, who have collaborated on a project or a book, article, report or paper within the last four (4) years. Include pending publications and submissions. Otherwise, state "None."

d. Names of each investigator's own graduate or post graduate advisors and advisees. The information provided in "c" and "d" is used to help identify potential conflicts or bias in the selection of reviewers.

e. The time commitment of each senior or key person to this project.

3. For the personnel categories of postdoctoral associates, other professionals, and students (research assistants), the proposal may include information on exceptional qualifications of these individuals that merit consideration in the evaluation of the proposal.

4. The biographical sketches are limited to three (3) pages per investigator and other individuals that merit consideration.

BIBLIOGRAPHY: A bibliography of pertinent literature is required. Citations must be complete (including full name of author(s), title, and location in the literature).

CURRENT AND PENDING SUPPORT:

1. All project support from whatever source must be listed. The list must include all projects requiring a portion of the principal investigator's and other senior personnel's time, even if they receive no salary support from the project(s) including Cooperative Research and Development Agreements (CRADAs) or other technology transfer agreements with federal labs. Funding provided under any award resulting from this BAA may only be used in support of the effort funded by that award, and not for any other project or purpose.

2. The information should include, as a minimum:
   a. the project/proposal title and brief description,
   b. the name and location of the organization or agency presently funding the work or requested to fund such work,
   c. the award amount or annual dollar volume of the effort,
   d. the period of performance, and
   e. a breakdown of the time required of the principal investigator and/or other senior personnel.

FACILITIES, EQUIPMENT, AND OTHER RESOURCES: The offeror should include in the proposal a listing of facilities, equipment, and other resources already available to perform the research proposed.

BUDGET PROPOSAL (including DD Form 1861):

1. Each proposal must contain a budget for each year of support requested and a cumulative budget for the full term of requested support. The budget form (Form 99) may be reproduced as needed. Locally produced versions may be used, but you may not make substitutions in prescribed budget categories nor alter or rearrange the cost categories as they appear on the form. The proposal may request funds under any of the categories listed so long as the item is considered necessary to perform the proposed work and is not precluded by applicable cost principles. Additionally, a budget by major proposed research tasks using the same budget categories must be included.

2. A signed summary budget page must be included. The documentation pages should be titled "Budget Explanation Page" and numbered chronologically starting with the budget form. The need for each item should be explained clearly.

3. All cost data must be current and complete. Costs proposed must conform to the following principles and procedures:

   Educational Institutions: 2 CFR Part 200 (formerly OMB Circular A-21) Nonprofit

Organizations: 2 CFR Part 200 (formerly OMB Circular A-122[6]) Commercial Organizations: FAR Part 31, DFARS Part 231, FAR Subsection 15.403-5, and DFARS Subsection 215.403-5.

4. Sample itemized budgets and the information they must include for a contract and for grants and cooperative agreements can be found at Section II. H. (Other Information). Before award it must be established that an approved accounting system and financial management system exist.

APPENDICES: Some situations require that special information and supporting documents be included in the proposal before funding can be approved. Such information and documentation should be included by appendix to the proposal.

c. Submission of Complete Research Proposals

Proposals must be submitted through the offeror's organizational office having responsibility for Government business relations. All signatures must be that of an official authorized to commit the organization in business and financial affairs. Proposals must be submitted electronically using one of the two following formats, based on award type sought. The content will remain the same whether using email or Grants.gov.

EMAIL SUBMISSION (for **Contracts only**):

1. Proposal requesting award of a contract must be emailed directly to usarmy.rtp.devcom-arl.mesg.qcbox@army.mil

   Do not email full proposals to the LQC Program Point of Contact. All e-mailed proposals must contain the information outlined in Section II, D, 2, entitled "*Table of Contents*" including the electronic forms as follows:

   (a) ARO Form 51, Proposal Cover Page;
   (b) ARO Form 99, Summary Proposal Budget or equivalent,
   (c) ARO Current and Pending Support (unnumbered form),
   (d) ARO Form 52 or ARO Form 52a.
   (e) "FAR 52.209-11 – Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law (Feb 2016). See Note below."

   These forms may be accessed at https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/ under BAA Forms. The fillable PDF forms may be saved to a working directory on a computer and opened and filled in using the latest compatible Adobe Reader software application found at this Grants.Gov: https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html

[6] For those nonprofit organizations specifically exempt from the provisions of 2 CFR Part 230, FAR Part 31 and DFARS Part 231 shall apply.

Note: A completed 52.209-11 – Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law (Feb 2016), is not required if the offeror's SAM Certifications and Representations have been updated annually since 2016. If the offeror's SAM has not be updated since March 2016, the completed representation must be submitted and include POC information and signature of the authorized representative.

2. All forms requiring signature must be completed, printed, signed, and scanned into a PDF document. All documents must be combined into a single PDF formatted file to be attached to the e-mail.

3. Proposal documents (excluding required forms) must use the following format:
   - Page Size – 8 ½ x 11 inches
   - Margins – 1 inch
   - Spacing – single
   - Font – Times New Roman, 12 point, single-sided pages

GRANTS.GOV SUBMISSION (For **all Assistance Instruments**)- Proposals requesting Assistance agreements must be submitted via Grants.gov:

1. Grants.gov Registration (See *Section II.D.2. f. Grants.gov Registration* below) must be accomplished prior to application through this process. Note- All web links referenced in this section and "*Grants.gov Registration"* (below) are subject to change by grants.gov and may not be updated here.

2. Specific forms are required for submission of a proposal. The forms are contained in the Application Package available through the Grants.gov application process. To access these materials, go to https://www.grants.gov/, select "Apply for Grants," and then select "Get Application Package." A Grant Application Package and Application Instructions are available for through the Grants.Gov Apply portal under CFDA Number 12.431/Funding Opportunity Number **W911NF-23-S-0004**. Select "Apply" and then "Apply Now Using Workspace." The following documents are mandatory: (1) Application for Federal Assistance (Research and Related) (SF 424 (R&R), and (2) Attachments form.

   (a) The SF 424 (R&R) form is to be used as the cover page for all proposals.

   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. The SF 424 (R&R) must be fully completed.

   (b) The Attachments form must contain the information outlined in Section II, D, 2 (*b. Preparing an Application*), entitled "Table of Contents" of this BAA including the electronic forms as follows:

(1) Research and Related Other Project Information;
(2) ARO Form 99, Summary Proposal Budget;
(3) ARO Current and Pending Support (unnumbered form)
(4) Representation by Corporations Regarding conviction of a Felony Criminal Violation under any Federal or State Law and Representation by Corporations Regarding an Unpaid Delinquent Tax Liability

Items (1)-(4) forms may be accessed at https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/ Item (4) "Representation relating to Tax Liability and Felony Convictions" may be submitted on a word document and attached to available field within the attachments form. The fillable PDF forms may be saved to a working directory on a computer and opened and filled in using the latest compatible Adobe Reader software application found at this Grants.Gov: https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html

Note: Representation by Corporations Regarding Conviction of a Felony Criminal Violation and Unpaid Delinquent Tax Liability require POC information and signature of the authorized representative.

(c) All documents must be combined into separate and single PDF formatted files titled using the Table of Contents names listed in "*Section II.D.2.b. Preparing an Application*": Preparation of complete Research Proposals". Include "**W911NF-23-S-0004**" in title so the proposal will be distinguished from other BAA submissions and upload using the mandatory Attachments form.

(d) The training demonstration at https://www.grants.gov/web/grants/applicants/applicant-training.html?inheritRedirect=true will assist AORs in the application process. Remember that you must open and complete the Application for Federal Assistance (Research and Related) (SF 424 (R&R)) first, as this form will automatically populate data fields in other forms. If you encounter any problems, contact customer support at 1-800-518-4726 or at support@grants.gov. If you forget your user name or password, follow the instructions provided in the Credential Provider tutorial. Tutorials may be printed by right-clicking on the tutorial and selecting "Print".

(e) As it is possible for grants.gov to reject the proposal during this process, it is strongly recommended that proposals be uploaded **at least two days** before any established deadline in the BAA so that they will not be received late and be ineligible for award consideration. It is also recommended to start uploading proposals at least two days before the deadline to plan ahead for any potential technical and/or input problems involving the applicant's own equipment.

(f) Grants.Gov Registration

Registration. Each organization that desires to submit applications via Grants.Gov

must complete a one-time registration. There are several one-time actions your organization must complete in order to submit applications through Grants.gov (e.g., obtain a Unique Entity Identifier, register with the SAM, register with the credential provider, register with Grants.gov and obtain approval for an authorized organization representative (AOR) to submit applications on behalf of the organization).To register please see http://www.grants.gov/web/grants/applicants/organization-registration.html

Please note the registration process for an Organization or an Individual can take between three to five business days or as long as four weeks if all steps are not completed in a timely manner.

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

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

Each applicant (unless the applicant is an individual or Federal awarding agency that is exempt from those requirements under 2 CFR §25.110(b) or (c), or has an exception approved by the Federal awarding agency under 2 CFR §25.110(d)) is required to:

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

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

4. Submission Dates and Times:

Proposals transmitted to be considered for award must be received by Grants.gov **no later than 4:00 PM Eastern Time on 21 March 2023.**

Applicants are responsible for submitting electronic proposals in sufficient time to insure Grants.gov receives it by the time specified in this BAA. If the electronic proposal is received by Grants.gov after the exact time and date specified for receipt of offers, it will be considered "late" and will not be considered for award. Acceptable evidence to establish the time of receipt by Grants.gov includes documentary evidence of receipt maintained by Grants.gov.

Because of potential problems involving the applicants' own equipment, to avoid the possibility of late receipt and resulting in ineligibility for award consideration, it is strongly recommended that proposals be uploaded at least two business days before the deadline established in the BAA.

If an emergency or unanticipated event interrupts normal Government processes so that proposals cannot be received at grants.gov by the exact time specified in the solicitation, and urgent Government requirements preclude amendment of the solicitation closing date, the time specified for receipt of proposals will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

Proposal Receipt Notices – After a proposal is submitted to Grants.gov, the AOR will receive a series of three emails from Grants.gov. The first two emails will be received within 24 to 48 hours after submission. The first email will confirm time of receipt of the application by the Grants.gov system and the second will indicate that the application has either been successfully validated by the system prior to transmission to the grantor agency or has been rejected due to errors. A third email will be received once the agency has confirmed receipt of the proposal. The document, Tracking Your Application Package, located at https://www.grants.gov/web/grants/applicants/track-my-application.html?inheritRedirect=true explains this process. The proposal is not considered received until the AOR receives email #3.

5. Intergovernmental Review

Not Applicable

6. Funding Guidance:

Multiple awards are anticipated. The actual amount of each award will be contingent on availability of funds and the scope of the proposed work. Depending on the results of the proposal evaluation, there is no guarantee that any of the proposals submitted in response to a particular program goal will be recommended for funding. Proposals may be funded in part.

7. Other Submission Requirements:

Information to Be Requested from Successful Offerors- Offerors whose proposals are accepted for funding will be contacted before award to provide additional information required for award. The required information is normally limited to clarifying budget explanations, representations, certifications, and some technical aspects.

For Contracts Only- Performance Work Statements (PWS) - prior to award the Contracting Officer may request that the contractor submit a PWS for the effort to be performed, which will be incorporated into the contract at the time of award.

An applicant may withdraw a proposal at any time before award by written notice or by email. Notice of withdrawal shall be sent to the Contracting/Grants Officer identified in

Section G, of this BAA. Withdrawals are effective upon receipt of notice by the Contracting/Grants Officer.

E. Application Review Information:

1. Criteria:

a. Proposals submitted in response to this BAA will be evaluated and a recommendation for selection be made on the following criteria:

(i) Scientific and Technical Merit of the Proposed Research
Overall scientific and technical merit of the proposal is substantiated, including unique and innovative methods, approaches, and/or concepts. The proposal clearly articulates an understanding of the problem to be solved. The technical approach is credible and includes a clear assessment of primary risks and a means to address them. The feasibility and likelihood that the proposed approach will satisfy the program's milestones and metrics are explicitly described and clearly substantiated along with risk mitigation strategies for achieving stated milestones and metrics. The proposed research advances the state of the art.

(ii) Potential Contribution of the Research to the Program Goal, and IARPA and DoD Missions
The proposed solution meets the stated program goals and all elements within the proposal exhibit a comprehensive understanding of the problem. The proposal clearly addresses how the proposed effort will meet and progressively demonstrate ELQ Program goals. The proposal describes how the proposed solution contributes to IARPA's and DoD's mission to invest in high-risk/high-payoff research that can provide the U.S. with an overwhelming advantage over its future adversaries. The proposed approach to intellectual property rights is in the Government's best interest.

(iii) Experience and qualifications of the principal investigator, other key research personnel, and the institution sponsoring the proposal
The Offeror's capabilities, related experience, facilities, techniques, or unique combination of these which are integral factors for achieving the proposal's objectives will be evaluated, as well as qualifications, capabilities, and experience of the proposed principal investigator, team leader, and key personnel critical in achieving the proposal objectives. Time commitments of key personnel must be sufficient for their proposed responsibilities in the effort.

2. Review and Selection Process:

The proposal selection process will be conducted based upon a technical review by a panel of government scientists according to the evaluation criteria specified in Section E.1 (*Criteria*). Each proposal will be evaluated based on the merit and relevance of the specific proposal as it relates to the research topic rather than against other proposals for research in the same general area.

Upon completion of an evaluation against the criteria in Section II.E.1, a proposal selected for possible award will be analyzed for the realism and reasonableness of costs and funds availability. Proposal costs must be determined reasonable and realistic before the Government can make an award.

For clarification, this solicitation will be conducted as an 'other competitive procedure,' in accordance with FAR 6.102 and FAR 35.016, and will not be conducted as a negotiated procurement under FAR Part 15. The Government will not conduct a comparative analysis or trade-off analysis among proposals, and discussions under FAR Part 15 will not be conducted.

While it is the Government's intention to make awards based on submitted proposals, the contracting officer, in his or her discretion, may choose to conduct post-selection negotiations with a specific offeror on any topic deemed necessary for the purpose of allowing that offeror to revise and improve its proposal.

3. Recipient Qualification

a. For Grant, Cooperative Agreement:

In accordance with OMB guidance in parts 180 and 200 of Title 2, CFR, it is DoD policy that DoD Components must report and use integrity and performance information in the Federal Awardee Performance and Integrity Information System (FAPIIS), or any successor system designated by OMB, concerning grants, cooperative agreements, and TIAs as follows:

(i) If the total Federal share will be greater than the simplified acquisition threshold on any Federal award under a notice of funding opportunity (see §200.88 Simplified Acquisition Threshold):

(a) The Federal awarding agency, prior to making a Federal award with a total amount of Federal share greater than the simplified acquisition threshold, will review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (currently FAPIIS) (see 41 U.S.C. 2313);

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

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

b. For Assistance awards recipients will be required to submit the following representation prior to award:

Representations under DoD Assistance Agreements: Appropriations Provisions on Tax Delinquency and Felony Convictions

The applicant is ( ) is not ( ) a "Corporation" meaning any entity, including any institution of higher education, other nonprofit organization, or for-profit entity that has filed articles of incorporation.

If the applicant is a "Corporation" please complete the following representations:

(1) The applicant represents that it is ( ) is not ( ) a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

(2) The applicant represents that it is ( ) is not ( ) is not a corporation that was convicted of a criminal violation under any Federal law within the preceding 24 months.

The "Representation relating to Tax Liability and Felony Convictions", the form may be accessed at https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/

NOTE: If an applicant responds in the affirmative to either of the above representations, the applicant is ineligible to receive an award unless the agency suspension and debarment official (SDO) has considered suspension or debarment and determined that further action is not required to protect the Government's interests. The applicant therefore should provide information about its tax liability or conviction to the agency's SDO as soon as it can do so, to facilitate completion of the required considerations before award decisions are made. Applicant's authorized representative must sign and date form.

c. For CONTRACT Proposals:

(i) The Federal Awardee Performance and Integrity Information System (FAPIIS) will be checked prior to making an award. The web address is: https://www.fapiis.gov/fapiis The applicant representing the entity may comment in this system on any information about itself that a Federal Government Official entered. The information in FAPIIS will be used in making a judgment about the entity's integrity, business ethics, and record of performance under Federal awards that may affect the official's determination that the applicant is qualified to receive an award.

(ii) For contracts, the following representation must be submitted prior to award if the offeror's SAM Representations and Certifications are not dated after March 2016. If the offeror's SAM Representations and Certifications have been updated after March 2016,

this representation is not required to be submitted separately.

FAR 52.209-11: Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law (Feb 2016)

(a) As required by sections 744 and 745 of Division E of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L 113-235), and similar provisions, if contained in subsequent appropriations acts, the Government will not enter into a contract with any corporation that--

(1) Has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, where the awarding agency is aware of the unpaid tax liability, unless an agency has considered suspension or debarment of the corporation and made a determination that suspension or debarment is not necessary to protect the interests of the Government; or

(2) Was convicted of a felony criminal violation under any Federal law within the preceding 24 months, where the awarding agency is aware of the conviction, unless an agency has considered suspension or debarment of the corporation and made a determination that this action is not necessary to protect the interests of the Government.

(b) The Offeror represents that—

(1) It is [ ] is not [ ] a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability; and

(2) It is [ ] is not [ ] a corporation that was convicted of a felony criminal violation under a Federal law within the preceding 24 months.

F. Award Administration Information:

1. Award Notices:

Initial notification of selection of proposals for funding will be e-mailed by ARO to successful offerors about 1 June 2023.

The notification e-mail of selection for funding must not be regarded as an authorization to commit or expend funds. The Government is not obligated to provide any funding until a Government Contracting/Grants Officer signs the grant, cooperative agreement or contract award document.

Applicants whose proposals are recommended for negotiation of award will be contacted by a

Contract/Grant Specialist to discuss additional information required for award. This may include representations and certifications, revised budgets or budget explanations, certificate of current cost or pricing data, subcontracting plan for small businesses, and other information as applicable to the proposed award.

2. Administrative and National Policy Requirements:

a. Required Certifications

(i) For CONTRACT Proposals:

Certifications Required for Contract Awards. Certifications and representations shall be completed by successful offerors prior to award. Federal Acquisition Regulation (FAR) Online Representations and Certifications are to be completed through SAM at website https://www.SAM.gov. Defense FAR Supplement and contract specific certification packages will be provided to the contractor for completion prior to award.

FAR 52.203-18, PROHIBITION ON CONTRACTING WITH ENTITIES THAT REQUIRE CERTAIN CONFIDENTIALITY AGREEMENTS OR STATEMENTS—REPRESENTATION (JAN 2017)

FAR 52.204-26, COVERED TELECOMMUNICATIONS EQUIPMENT OR SERVICES-REPRESENTATION (OCT 2020)
a) Definitions. As used in this provision, "covered telecommunications equipment or services" and "reasonable inquiry" have the meaning provided in the clause 52.204-25, Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.
(b) Procedures. The Offeror shall review the list of excluded parties in the System for Award Management (SAM) (https://www.sam.gov) for entities excluded from receiving federal awards for "covered telecommunications equipment or services".
(c)(1) Representation. The Offeror represents that it [ ] does, [ ] does not provide covered telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument.
(2) After conducting a reasonable inquiry for purposes of this representation, the offeror represents that it [ ] does, [ ] does not use covered telecommunications equipment or services, or any equipment, system, or service that uses covered telecommunications equipment or services.

(ii) For GRANT and COOPERATIVE AGREEMENT Proposals:

Grant awards greater than $100,000 require a certification of compliance with a national policy mandate concerning lobbying. Statutes and Government-wide regulations require the certification to be submitted prior to award. The certification is set forth at Appendix A to 32 CFR 28 regarding lobbying. When submitting your grant through Grants.gov, by completing blocks 18 and 19 of the Standard Form 424 Research and Related (R&R) Form, the grant applicant is providing the certification on lobbying required by 32 CFR

Part 28, otherwise a signed copy by the authorized representative must be provided. Below is the required certification:

(a). CERTIFICATION AT APPENDIX A TO 32 CFR PART 28 REGARDING LOBBYING: Certification for Contracts, Grants, Loans, and Cooperative Agreements The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) 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 this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

(b). PROHIBITION ON CONTRACTING WITH ENTITIES THAT REQUIRED CERTAIN INTERNAL CONFIDENTIALITY AGREEMENTS – REPRESENTATION

Agreement with the representation below will be affirmed by checking the “I agree” box in block 17 of the SF424 (R&R) as part of the electronic proposal submitted via Grants.gov. The representation reads as follows:

By submission of its proposal or application, the applicant represents that it does not require any of its employees, contractors, or subrecipients seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting those employees, contractors, subrecipients from

lawfully reporting that waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

Note that: (1) the basis for this representation is a prohibition in section 743 of the Financial Services and General Government Appropriations Act, 2015, Pub. L. 113-235) on provision of funds through grants and cooperative agreements to entities with certain internal confidentiality agreements or statements; and 2) section 743 states that it does not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

b. Policy Requirements

i. PROTECTION OF HUMAN SUBJECTS:

(1) For Assistance Instruments:

(a) The recipient must protect the rights and welfare of individuals who participate as human subjects in research under this award and comply fully with the requirements at 32 CFR part 219, Department of Defense Instruction (DoDI) 3216.02, 10 U.S.C. 980, the National Policy Requirements Concerning Live Organisms Terms and Conditions (Section A.1., Human Subjects, at 81 Federal Register 78380, Appendix C to Part 1122), and when applicable, Food and Drug Administration (FDA) policies and regulations.

(b) The recipient must not begin performance of research involving human subjects, also known as human subjects research (HSR), that is covered under 32 CFR part 219, or that meets exemption criteria under 32 CFR 219.101(b), or expends funding on such effort, until you receive a formal notification of approval from the cognizant DoD Human Research Protection Official (HRPO). Approval to perform HSR under this award is received after the HRPO has performed a review of the recipient's documentation of planned HSR activities and has officially furnished a concurrence with the recipient's determination as presented in the documentation.

(c) In order for the HRPO to accomplish this concurrence review, the recipient must provide sufficient documentation to enable his or her assessment as follows:

(i) If the HSR meets an exemption criteria under 32 CFR 219.101(b), the documentation must include a citation of the exemption category under 32 CFR 219.101(b) and a rationale statement.

(ii) If the recipient's activity is determined as "non-exempt research involving human subjects", the documentation must include:

- − Assurance of Compliance (a written assurance that an institution will comply with requirements of 32 CFR Part 219, as well as the terms of the assurance) appropriate for the scope of work or program plan; and
- − Institutional Review Board (IRB) approval, as well as all documentation reviewed by the IRB to make their determination.

(d) The HRPO retains final judgment on what activities constitute HSR, whether an exempt category applies, whether the risk determination is appropriate, and whether the planned HSR activities comply with the requirements in paragraph (a) of this section.

(e) The recipient must notify the Grants Officer/Agreements Officer immediately of any suspensions or terminations of the Assurance of Compliance.

(f) DoD staff, consultants, and advisory groups may independently review and inspect the recipient's research and research procedures involving human subjects and, based on such findings, DoD may prohibit research that presents unacceptable hazards or otherwise fails to comply with DoD requirements.

(g) Definitions for terms used in this section are found in DoDI 3216.02.

(2) For Contracts: DFARS clause 252.235-7004 is applicable to this solicitation and will be included in any resultant contract award that supports research that includes or may include HSR.

ii. ANIMAL USE:

(1) Assistance Instruments:

(a) Prior to initiating any animal work under the award, the recipient must:

(i) Register the recipient's research, development, test, and evaluation or training facility with the Secretary of Agriculture in accordance with 7 U.S.C. 2136 and 9 CFR section 2.30, unless otherwise exempt from this requirement by meeting the conditions in 7 U.S.C. 2136 and 9 CFR parts 1-4 for the duration of the activity.

(ii) Have the recipient's proposed animal use approved in accordance with DoDI 3216.01, Use of Animals in DoD Programs by a DoD Component Headquarters Oversight Office.

(iii) Furnish evidence of such registration and approval to the grants officer.

(b) The recipient must make the animals on which the research is being conducted, and all premises, facilities, vehicles, equipment, and records that support animal care and use available during business hours and at other times mutually agreeable to the

recipient, the United States Department of Agriculture Office of Animal and Plant Health Inspection Service (USDA/APHIS) representative, personnel representing the DoD component oversight offices, as well as the grants officer, to ascertain that the recipient is compliant with 7 U.S.C. 2131 et seq., 9 CFR parts 1-4, and DoDI 3216.01.

(c) The recipient's care and use of animals must conform with the pertinent laws of the United States, regulations of the Department of Agriculture, and regulations, policies, and procedures of the DoD (see 7 U.S.C. 2131 et seq., 9 CFR parts 1-4, and DoDI 3216.01).

(d) The recipient must acquire animals in accordance with DoDI 3216.01.

(2) Contracts: The appropriate clauses shall be added to the award.

(iv)BIOLOGICAL DEFENSE SAFETY PROGRAM REQUIREMENTS:
(1) Assistance Instruments and Contracts: Awards may be subject to biological safety program requirements IAW:

(a) Army Regulation (AR) 385-10, Chapter 20
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN16777_ARN16343_AR385_10_FINAL.pdf

(b) Department of Army (DA) Pamphlet (PAM) 385-69 on safety standards for microbiological and biomedical laboratories. This pamphlet requires the mandatory use of the latest edition of the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention (CDC) and National Institutes of Health's (NIH) Biosafety in Microbiological and Biomedical Laboratories (BMBL)
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/p385_69.pdf _

(c) DoD Manual 6055.18-M, Enclosure 4, Section 13
https://www.hsdl.org/?view&did=24365

(v) MILITARY RECRUITING:

(1) Assistance Instruments: This is to notify potential applicants that each grant or cooperative agreement awarded under this announcement to an institution of higher education must include the following term and condition:

(a) As a condition for receiving funds available to the DoD under this award, you agree that you are not an institution of higher education (as defined in 32 CFR part 216) that has a policy or practice that either prohibits, or in effect prevents:

(i) The Secretary of a Military Department from maintaining, establishing, or operating a unit of the Senior Reserve Officers Training Corps (ROTC)—-in accordance with 10 U.S.C. 654 and other applicable Federal laws—-at that institution (or any sub-element of that institution);

(ii) Any student at that institution (or any sub-element of that institution) from enrolling in a unit of the Senior ROTC at another institution of higher education.

(iii) The Secretary of a Military Department or Secretary of Homeland Security from gaining access to campuses, or access to students (who are 17 years of age or older) on campuses, for purposes of military recruiting in a manner that is at least equal in quality and scope to the access to campuses and to students that is provided to any other employer; or

(iv) Access by military recruiters for purposes of military recruiting to the names of students (who are 17 years of age or older and enrolled at that institution or any sub-element of that institution); their addresses, telephone listings, dates and places of birth, levels of education, academic majors, and degrees received; and the most recent educational institutions in which they were enrolled.

(b) If you are determined, using the procedures in 32 CFR part 216, to be such an institution of higher education during the period of performance of this award, we:

(i) Will cease all payments to you of DoD funds under this award and all other DoD grants and cooperative agreements; and

(ii) May suspend or terminate those awards unilaterally for material failure to comply with the award terms and conditions.

(vi) SUBCONTRACTING: For Contracts Only. This section is applicable to contracts

(1) Assistance Instruments: N/A

(2) Contracts: Pursuant to Section 8(d) of the Small Business Act (15 U.S.C. § 637(d)), it is the policy of the Government to enable small business and small disadvantaged business (SDB) concerns to be considered fairly as subcontractors. All other than U.S. small businesses proposing contracts expected to exceed $750,000 and that have subcontracting possibilities are required to submit a subcontracting plan IAW FAR 19.702(a), and shall do so with their proposal.

Subcontracting plans are determined to be acceptable or unacceptable based on the criteria established at FAR 19.705-4, DFARS 219.705-4, and AFARS 5119.705-4. Goals are established on an individual contract basis and should result in realistic, challenging and attainable goals that, to the greatest extent possible, maximize small business participation in subcontracting for Small Business, SDB, Woman-Owned Small Business (WOSB), Economically-Disadvantaged Women-Owned Small Business (EDWOSB), Service-Disabled Veteran-Owned Small Business (SDVOSB), Veteran-Owned Small Business (VOSB), and Historically Underutilized Business Zone (HUBZone) Small Business consistent with applicants' make-or-buy policy, the pool of and availability of qualified and capable small business subcontractors, their performance on subcontracts, and existing relationships with suppliers.

Subcontracting goals should result in efficient contract performance in terms of cost, schedule, and performance and should not result in increased costs to the Government or undue administrative burden to the prime contractor. More information on the Subcontracting program and the DoD Subcontracting goals may be found at: https://business.defense.gov/About/Goals-and-Performance/

(vii) EXPORT CONTROL LAWS:

(1) Assistance Instruments: N/A

(2) Contracts: Applicants should be aware of current export control laws and are responsible for ensuring compliance with all export control laws, including International Traffic in Arms Regulation (ITAR) (22 CFR 120 et. Seq.) and the Export Administration Regulations (15 CFR 730) requirements, as applicable. In some cases, developmental items funded by the Department of Defense are now included on the United States Munition List (USML) and are therefore subject to ITAR jurisdiction. The USML is available online at http://www.ecfr.gov/cgi-bin/text-idx?node=pt22.1.121. Additional information regarding the President's Export Control Reform Initiative can be found at http://export.gov/ecr/index.asp.

vii. DRUG-FREE WORKPLACE:

(1) Assistance Instruments: The recipient must comply with drug-free workplace requirements in 32 CFR Part 26, which is the DoD implementation of 41 U.S.C. 701, “Drug-free workplace requirements for Federal contractors.”

(2) Contracts: The appropriate clause(s) shall be added to the award.

viii. DEBARMENT AND SUSPENSION:

(1) Assistance Instruments: The recipient must comply with requirements regarding debarment and suspension in Subpart C of 2 CFR part 180, as adopted by DoD at 2 CFR part 1125. This includes requirements concerning the recipient’s principals under an award, as well as requirements concerning the recipient’s procurement transactions and subawards that are implemented in DoD Research and Development General Terms and Conditions.

(2) Contracts: The appropriate clause(s) shall be added to the award.

ix. REPORTING SUBAWARDS AND EXECUTIVE COMPENSATION:

(1) Assistance Instruments: The recipient must report information about subawards and executive compensation as specified in the award term in Appendix A to 2 CFR part 170, “Reporting subaward and executive compensation information,” modified as follows:

(a) To accommodate any future designation of a different Government wide Web site for reporting subaward information, the Web site "http://www.fsrs.gov" cited in paragraphs a.2.i. and a.3 of the award provision is replaced by the phrase "http://www.fsrs.gov or successor OMB designated Web site for reporting subaward information";

(b) To accommodate any future designation of a different Government wide Web site for reporting executive compensation information, the Web site "http://www.sam.gov" cited in paragraph b.2.i. of the award provision is replaced by the phrase "https://www.sam.gov or successor OMB-designated Web site for reporting information on total compensation";

(2) Contracts: The appropriate clause(s) shall be added to the award.

x. CONFLICT OF INTEREST/CONFLICT OF COMMITMENT REVIEW:

This announcement requires all current and pending research support, as defined by Section 223 of the FY21 National Defense Authorization Act, must be disclosed at the time of proposal submission, for all covered individuals. Such disclosure will be updated annually during the performance of any research project selected for funding, and whenever covered individuals are added or identified as performing under the funded project. Covered Individuals are those who are listed as key personnel on proposals, including but not restricted to, the principal investigator or co-principal investigator.

Any decision to accept a proposal for funding under this announcement will include full reliance on the applicant's statements. Failure to report fully and completely all sources of project support and outside positions and affiliations may be considered a materials statement within the meaning of the False Claims Act, 31 U.S.C. 3729, and constitute a violation of Federal law.

ARL may conduct a pre-award conflict of interest/conflict of commitment review, as defined in the National Security Presidential Memorandum- 33, of any proposal selected for funding. Applicants are advised that any significant conflict of interest/conflict of commitment identified may be a basis for the rejection of an otherwise awardable proposal.

3. Reporting:

Reports including number and types will be specified in the award document, but will include as a minimum quarterly technical and financial status reports. The reports shall be prepared and submitted in accordance with the procedures contained in the award document and mutually agreed upon before award. Reports and briefing material will also be required as appropriate to document progress in accomplishing program metrics.

Service Contract Reporting (SCR). For Contracts Only. See FAR 52.204-14, SAM Users Guide and DoD Guidebook for Service Contract Reporting in the System for Award Management at https://dodprocurementtoolbox.com/cms/sites/default/files/resources/2020-10/SCR%20Guidebook%2021%20October%202020.pdf.

If the total Federal share exceeds $500,000 on any Federal award under a notice of funding opportunity, the post-award reporting requirements reflected in Appendix XII to Part 200 of Title 2 CFR will be included in the award document. This requirement also applies to modifications of awards that: 1) increase the scope of the award, 2) are issued on or after January 1, 2016, and 3) increase the federal share of the award's total value to an amount that exceeds $500,000.

G. Agency Contacts:

Questions of a technical nature or a programmatic nature shall be directed as specified below:

Technical Program Point of Contact (ARO):
Dr. T.R. Govindan
Army Research Office
Email Address: t.r.govindan.civ@army.mil

Questions of a business nature shall be directed to the contact info, as specified below:

Email address: usarmy.rtp.devcom-arl.mesg.qcbox@army.mil

Comments or questions submitted should be concise and to the point, eliminating any unnecessary verbiage. In addition, the relevant part and paragraph of the Broad Agency Announcement (BAA) should be referenced.

H. Other Information:

Below are 2 separate outlines of the informational requirements for a sample cost proposal. H.1. is for a procurement contract and H.2 for grants and cooperative agreements.

CONTRACT Proposals:

Cost Proposal – {No Page Limit} Cover sheet to include:

(1) BAA number;
(2) Technical area;
(3) Lead Organization submitting proposal;
(4) Type of business, selected among the following categories: "LARGE BUSINESS", "SMALL DISADVANTAGED BUSINESS", "OTHER SMALL BUSINESS", "HBCU", "MI", "OTHER EDUCATIONAL", OR "OTHER NONPROFIT";
(5) Contractor's reference number (if any);
(6) Other team members (if applicable) and type of business for each;
(7) Proposal title;
(8) Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available);

(9) Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), and electronic mail (if available);
(10) Award instrument requested: cost-plus-fixed-free (CPFF), cost-contract—no fee, cost sharing contract – no fee, or other type of procurement contract (specify).
(11) Place(s) and period(s) of performance;
(12) Total proposed cost separated by basic award and option(s) (if any);
(13) Name, address, and telephone number of the offeror's cognizant Defense Contract Management Agency (DCMA) administration office (if known);
(14) Name, address, and telephone number of the offeror's cognizant Defense Contract Audit Agency (DCAA) audit office (if known);
(15) Date proposal was prepared;
(16) DUNS number;
(17) TIN number; and
(18) Cage Code;
(19) Subcontractor Information; and
(20) Proposal validity period
(21) Any Forward Pricing Rate Agreement, other such approved rate information, or such other documentation that may assist in expediting negotiations (if available).

I. Reasoning for Submitting a Strong Cost Proposal

The ultimate responsibility of the Contracting Officer is to ensure that all prices offered in a proposal are fair and reasonable before contract award [FAR 15.4]. To establish the reasonableness of the offered prices, the Contracting Officer may ask the offeror to provide various supporting documentation that assists in this determination. The offeror's ability to be responsive to the Contracting Officer's requests can expedite contract award. As specified in Section 808 of Public Law 105-261, an offeror who does not comply with a requirement to submit information for a contract or subcontract in accordance with paragraph (a)(1) of FAR 15.403-3 may be ineligible for award.

II. DCAA-Accepted Accounting System

A) Before a contract can be awarded, the Contracting Officer must confirm that the offeror has a Defense Contract Audit Agency (DCAA)-accepted accounting system in place for accumulating and billing costs under Government contracts [FAR 53.209-1(f)]. If the offeror has DCAA correspondence, which documents the acceptance of their accounting system, this should be provided to the Contracting Officer (i.e. attached or referenced in the proposal). Otherwise, the Contracting Officer will submit an inquiry directly to the appropriate DCAA office and request a review of the offeror's accounting system.

B) If an offeror does not have a DCAA-accepted accounting system in place, the DCAA review process can take several months depending upon the availability of the DCAA auditors and the offeror's internal processes. This will cause a delay in contract award.

C) For more information about cost proposals and accounting standards, view the link titled "Information for Contractors" on the main menu on their website. III.

Field Pricing Assistance

During the pre-award cost audit process, the Contracting Officer will solicit support from DCAA to determine commerciality and price reasonableness of the proposal [FAR 15.404-2]. Any proprietary information or reports obtained from DCAA field audits will be appropriately identified and protected within the Government.

IV. Sample Cost Proposal – "Piece by Piece"

A) To help guide offerors through the pre-award cost audit process, a sample cost proposal is detailed below. This sample also allows the offeror to see exactly what the Government is looking for; therefore, all cost and pricing back-up data can be provided to the Government in the first cost proposal submission. Review each cost element within the proposal, and take note of the types of documentation that the Contracting Officer will require from the offeror.

B) Direct Labor: The first cost element included in the cost proposal is Direct Labor. The Department of Defense (DoD) requires each proposed employee to be listed by name and labor category.

Below is the Direct Labor as proposed by our sample offeror:

DIRECT LABOR		YEAR 1			YEAR 2		
Employee Name	Labor Category	Direct Hourly Rate	Hours	Total Direct Labor	Direct Hourly Rate	Hours	Total Direct Labor
Andy Smith	Program Manager	$55.00	720.00	$39,600.00	$56.65	720.00	$40,788.00
Bryan Andrew	Senior Engineer	$40.00	672.00	$26,880.00	$41.20	672.00	$27,686.40
Cindy Thomas	Principal Engineer	$50.00	512.00	$25,600.00	$51.50	512.00	$26,368.00
David Porter	Entry Level Engineer	$10.00	400.00	$4,000.00	$10.30	400.00	$4,120.00
Edward Bean	Project Administrator	$25.00	48.00	$1,200.00	$25.75	48.00	$1,236.00
Subtotal Direct Labor (DL)				$97,280.00			$100,198.40

1) For this cost element, the Contracting Officer requires the offeror to provide adequate documentation in order to determine that each labor rate for each employee/labor category is fair and reasonable. The documentation will need to explain how these labor rates were derived. For example, if the rates are DCAA- approved labor rates, provide the Contracting Officer with copies of the DCAA documents stating the approval. This is the most acceptable means of documentation to determine the rates fair and reasonable. Other types of supporting documentation may include General Service Administration (GSA) contract price lists, actual payroll journals, or Salary.com research. If an employee listed in a cost proposal is not a current employee (maybe a new employee, or one contingent upon the

award of this contract), a copy of the offer letter stating the hourly rate - signed and accepted by the employee - may be provided as adequate documentation. Sometimes the hourly rates listed in a proposal are derived through subjective processes, i.e., blending of multiple employees in one labor category, or averaged over the course of the year to include scheduled payroll increases, etc. These situations should be clearly documented for the Contracting Officer.

2) Another cost element in Direct Labor is labor escalation, or the increase in labor rates from Year 1 to Year 2. In the example above, the proposed labor escalation is 3% (ex., Andy Smith increased from $55.00/hr in Year 1, by 3% to $56.65/hr in Year 2). Often times, an offeror may not propose escalation on labor rates during a 24-month period. Whatever the proposed escalation rate is, please be prepared to explain why it is fair and reasonable [ex., A sufficient explanation for our sample escalation rate would be the Government's General Schedule Increase and Locality Pay for the same time period (name FY) in the same location (name location) was published as 3.5%, therefore a 3% increase is fair and reasonable].

C) Other Direct Costs (ODCs): This section of the cost proposal includes all other directly related costs required in support of the effort i.e., materials, subcontractors, consultants, travel, etc. Any cost element that includes various items will need to be detailed in a cost breakdown to the Contracting Officer.

1) Direct Material Costs: This subsection of the cost proposal will include any special tooling, test equipment, and material costs necessary to perform the project. Items included in this section will be carefully reviewed relative to need and appropriateness for the work proposed, and must, in the opinion of the Contracting Officer, be advantageous to the Government and directly related to the specific topic.

   a) The Contracting Officer will require adequate documentation from the offeror to determine the cost reasonableness for each material cost proposed. The following methods are ways in which the Contracting Officer can determine this [FAR 15.403-1].

      i) Adequate Price Competition. A price is based on adequate price competition when the offeror solicits and receives quotes from two or more responsible vendors for the same or similar items or services. Based on these quotes, the offeror selects the vendor who represents the best value to the Government. The offeror will be required to provide copies of all vendor quotes received to the Contracting Officer.

         Note: Price competition is not required for items at or below the micropurchase threshold ($5,000) [FAR 15.403-1]. If an item's unit cost is less than or equal to $5,000 price competition is not necessary. However, if an item's total cost over the period of performance (unit cost * quantity is higher than $5,000, two or more quotes must be obtained by the offeror.

      ii) Commercial Prices. Commercial prices are those published on current price lists, catalogs, or market prices. This includes vendors who have prices published on a GSA-schedule contract. The offeror will be required to provide copies of such price lists to the Contracting Officer.

      iii) Prices set by law or regulation. If a price is mandated by the Government (i.e.

pronouncements in the form of periodic rulings, reviews, or similar actions of a governmental body, or embodied in the laws) that is sufficient to set a price.

b) Below is the list of Direct Material costs included in our sample proposal:

i)

DIRECT MATERIAL COSTS:	YEAR 1	YEAR 2
Raw Materials	$35,000.00	$12,000.00
Computer for experiments	$4,215.00	$0.00
Cable (item #12-3657, 300 ft)	$1,275.00	$0.00
Software	$1,825.00	$1,825.00
Subtotal Direct Materials Costs (DM):	$42,315.00	$13,825.00

ii) "Raw Materials": This is a generic label used to group many material items into one cost item within the proposal. The Contracts Officer will require a detailed breakout of all the items that make up this cost. For each separate item over $3,000 (total for Year 1 + Year 2), the offeror must be able to provide either competitive quotes received, or show that published pricing was used.

iii) "Computer for experiments": Again, this item is most likely a grouping of several components that make up one system. The Contracts Officer will require a detailed breakout of all the items that make up this cost. For each separate item over $3,000 (total for Year 1 + Year 2), the offeror must be able to provide either competitive quotes received, or show that published pricing was used.

iv) "Cable": Since this item is under the micro purchase threshold of $5,000, competitive quotes or published pricing are not required. Simply provide documentation to show the Contracting Officer where this price came from.

v) "Software": This cost item could include either one software product, or multiple products. If this includes a price for multiple items, please provide the detailed cost breakdown. Note: The price for Year 1 ($1,825) is below the micro purchase threshold; however, in total (Year 1 + Year 2) the price is over $5,000, so competitive quotes or published pricing documentation must be provided.

c) Due to the specialized types of products and services necessary to perform these projects, it may not always be possible to obtain competitive quotes from more than one reliable source. Each cost element over the simplified acquisition threshold ($5,000) must be substantiated. There is always an explanation for HOW the cost of an item was derived; show us how you came up with that price!

d) When it is not possible for an offeror to obtain a vendor price through competitive quotes or published price lists, a Contracting Officer may accept other methods to determine cost reasonableness. Below are some examples of other documentation, which the Contracting Officer may accept to substantiate costs:

i) Evidence that a vendor/supplier charged another offeror a similar price for

similar services. Has the vendor charged someone else for the same product? (Two (2) to three (3) invoices from that vendor to different customers may be used as evidence.)

ii) Previous contract prices. Has the offeror charged the Government a similar price under another Government contract for similar services? If the Government has already paid a certain price for services, then that price may already be considered fair and reasonable. (Provide the contract number, and billing rates for reference.)

iii) DCAA approved. Has DCAA already accepted or verified specific cost items included in your proposal? (Provide a copy of DCAA correspondence that addressed these costs.)

2) Below is the remaining ODC portion of our proposal including equipment, subcontractors, consultants, and travel. Assume in this scenario that competitive quotes or catalog prices were not available for these items:

OTHER DIRECT COSTS:	YEAR 1	YEAR 2
Equipment Rental for Analysis	$5,500.00	$5,600.00
Subcontractor – Lockheed	$25,000.00	$0.00
Consultant: John Bowers	$0.00	$12,000.00
Travel	$1,250.00	$1,250.00
Subtotal Other Direct Costs (ODC):	$31,750.00	$18,850.00

a) "Equipment Rental for Analysis": The offeror explains that the Year 1 cost of $5,500 is based upon 250 hours of equipment rental at an hourly rate of $22.00/hr. One (1) invoice from the vendor charging another vendor the same price for the same service is provided to the Contracting Officer as evidence. Since this cost is over the simplified acquisition threshold, further documentation to determine cost reasonableness is required. The offeror is able to furnish another invoice charging a second vendor the same price for the same service.

b) "Subcontractor – Widget, Inc.": The offeror provides a copy of the subcontractor quote to the Contracting Officer in support of the $25,000 cost. This subcontractor quote must include sufficient detailed information (equivalent to the data included in the prime's proposal to the Government), so that the Contracting Officer can make a determination of cost reasonableness.

i) As stated in Section 3.5(c)(6) of the DoD Cost Proposal guidance, "All subcontractor costs and consultant costs must be detailed at the same level as prime contractor costs in regards to labor, travel, equipment, etc. Provide detailed substantiation of subcontractor costs in your cost proposal."

ii) In accordance with FAR 15.404-3, "the Contracting Officer is responsible for the determination of price reasonableness for the prime contract, including subcontracting costs". This means that the subcontractor's quote/proposal may be subject to the same scrutiny by the Contracting Officer as the cost proposal

submitted by the prime. The Contracting Officer will need to determine whether the subcontractor has an accepted purchasing system in place and/or conduct appropriate cost or price analyses to establish the reasonableness of proposed subcontract prices. Due to the proprietary nature of cost data, the Subcontractor may choose to submit their pricing information directly to the Contracting Officer and not through the prime. This is understood and encouraged.

iii) When a subcontractor is selected to provide support under the prime contract due to their specialized experience, the Contracting Officer may request sole source justification from the offeror.

c) "Consultant – John Bowers": Again, the offeror shall provide a copy of the consultant's quote to the Contracting Officer as evidence. In this example, the consultant will be charging an hourly rate of $125 an hour for 96 hours of support. The offeror indicates to the Contracting Officer that this particular consultant was used on a previous contract with the Government (provide contract number), and will be charging the same rate. A copy of the consultant's invoice to the offeror under the prior contract is available as supporting evidence. Since the Government has paid this price for the same services in the past, determination has already been made that the price is fair.

d) "Travel": The Contracting Officer will require a detailed cost breakdown for travel expenses to determine whether the total cost is reasonable based on Government per diem and mileage rates. This breakdown shall include the number of trips, the destinations, and the number of travelers. It will also need to include the estimated airfare per round trip, estimated car rental, lodging rate per trip, tax on lodging, and per diem rate per trip. The lodging and per diem rates must coincide with the Joint Travel Regulations. Please see the following website to determine the appropriate lodging and per diem rates: http://www.defensetravel.dod.mil/site/perdiemCalc.cfm
Additionally, the offeror must provide why the airfare is fair and reasonable as well. Sufficient back up for both airfare and car rental would include print outs of online research at the various travel search engines (Expedia, Travelocity, etc.) documenting the prices for airfare and car rentals thus proving why your chosen rate is fair and reasonable.

i) Below is a sample of the travel portion:

TRAVEL		Trips	Travelers	Nights	Days	Unit Cost	Total Travel
Airfare	per roundtrip	1	1			$996.00	$996.00
Lodging	per day	1	1	1		$75.00	$75.00
Tax on							
Lodging							
(12%)	per day	1	1	1		$9.00	$9.00
Per Diem	per day	1	1		2	$44.00	$88.00
Automobile					2		
Rental	per day	1	1			$41.00	$82.00
Subtotal Travel							$1,250.00

D) Indirect Rates: Indirect rates include elements such as Fringe Benefits, General & Administrative (G&A), Overhead, and Material Handling costs. The offeror shall indicate in the cost proposal both the indirect rates (as a percentage) as well as how those rates are allocated to the costs in the proposal.

INDIRECTS	YEAR 1	YEAR 2
Subtotal Direct Labor (DL):	$97,280.00	$100,198.40
Fringe Benefits, if not included in Overhead, rate (15.0000 %) X DL =	$14,592.00	$15,029.76
Labor Overhead (rate 45.0000 %) X (DL + Fringe) =	$50,342.40	$51,852.67
Total Direct Labor (TDL):	$162,214.40	$167,080.83

1) In this example, the offeror includes a Fringe Benefit rate of 15.00% that it allocated to the Direct Labor costs. They also propose a Labor Overhead rate of 45.00% that is allocated to the Direct Labor costs plus the Fringe Benefits.

2) All indirect rates and the allocation methods of those rates must be verified by the Contracting Officer. In most cases, DCAA documentation supporting the indirect rates and allocation methods can be obtained through a DCAA field audit or proposal review. Many offerors have already completed such reviews and have this documentation readily available. If an offeror is unable to participate in a DCAA review to substantiate indirect rates, the Contracting Officer may request other accounting data from the offeror to make a determination.

E.) Cost of Money (COM): If Cost of Money (an imputed cost that is not a form of interest on borrowings (see FAR 31.205-20); an "incurred cost" for cost-reimbursement purposes under applicable cost-reimbursement contracts and for progress payment purposes under fixed-price contracts; and refers to— (1) Facilities capital cost of money (48 CFR 9904.414); and (2) Cost of money as an element of the cost of capital assets under construction (48 CFR 9904.417)) is proposed in accordance with FAR 31.205-10, a DD Form 1861 is required to be completed and submitted with the contractor's proposal.

F.) Fee/Profit: The proposed fee percentage will be analyzed in accordance with DFARS 215.404, the Weighted Guidelines Method.

G.) Subcontracting Plan: If the total amount of the proposal exceeds $750,000 and the offeror is a large business or an institute of higher education (other than HBCU/MI) and the resultant award is a contract, the offeror shall be prepared to submit a subcontracting plan for small business and small disadvantaged business concerns. A mutually agreeable plan will be included in and made a part of the contract (see the goals listed at Section II, F, 2, b).

GRANT and COOPERATIVE AGREEMENT Proposals:

Before award it must be established that an approved accounting system and

financial management system exist.

A.) Direct Labor: Show the current and projected salary amounts in terms of man-hours, man- months, or annual salary to be charged by the principal investigator(s), faculty, research associates, postdoctoral associates, graduate and undergraduate students, secretarial, clerical, and other technical personnel either by personnel or position. State the number of man-hours used to calculate a man-month or man-year. For proposals from universities, research during the academic term is deemed part of regular academic duties, not an extra function for which additional compensation or compensation at a higher rate is warranted. Consequently, academic term salaries shall not be augmented either in rate or in total amount for research performed during the academic term. Rates of compensation for research conducted during non-academic (summer) terms shall not exceed the rate for the academic terms. When part or all of a person's services are to be charged as project costs, it is expected that the person will be relieved of an equal part or all of his or her regular teaching or other obligations. For each person or position, provide the following information:

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

B.) Fringe Benefits and Indirect Costs (Overhead, General and Administrative, and Other): The most recent rates, dates of negotiation, the base(s) and periods to which the rates apply must be disclosed and a statement included identifying whether the proposed rates are provisional or fixed. If the rates have been negotiated by a Government agency, state when and by which agency. A copy of the negotiation memorandum should be provided. If negotiated forecast rates do not exist, offerors must provide sufficient detail to enable a determination to be made that the costs included in the forecast rate are allocable according to applicable OMB Circulars or FAR/DFARS provisions. Offerors' disclosure should be sufficient to permit a full understanding of the content of the rate(s) and how it was established. As a minimum, the submission should identify:

1) All individual cost elements included in the forecast rate(s);
2) Bases used to prorate indirect expenses to cost pools, if any;
3) How the rate(s) was calculated;
4) Distribution basis of the developed rate(s);

5) Bases on which the overhead rate is calculated, such as "salaries and wages" or "total costs," and

6) The period of the offeror's fiscal year.

C.) Permanent Equipment: If facilities or equipment are required, a justification why this property should be furnished by the Government must be submitted. State the organization's inability or unwillingness to furnish the facilities or equipment. Offerors must provide an itemized list of permanent equipment showing the cost for each item. Permanent equipment is any article or tangible nonexpendable property having a useful life of more than one year and an acquisition cost of $5,000 or more per unit. The basis for the cost of each item of permanent equipment included in the budget must be disclosed, such as:

1) Vendor Quote: Show name of vendor, number of quotes received and justification, if intended award is to other than lowest bidder.

2) Historical Cost: Identify vendor, date of purchase, and whether or not cost represents lowest bid. Include reason(s) for not soliciting current quotes.

3) Engineering Estimate: Include rationale for quote and reason for not soliciting current quotes. If applicable, the following additional information shall be disclosed in the offeror's cost proposal:

4) Special test equipment to be fabricated by the awardee for specific research purposes and its cost.

5) Standard equipment to be acquired and modified to meet specific requirements, including acquisition and modification costs, listed separately.

6) Existing equipment to be modified to meet specific research requirements, including modification costs. Do not include equipment the organization will purchase with its funds if the equipment will be capitalized for Federal income tax purposes. Proposed permanent equipment purchases during the final year of an award shall be limited and fully justified.

7) Grants and cooperative agreements may convey title to an institution for equipment purchased with project funds. At the discretion of the contracting/grants officer, the agreement may provide for retention of the title by the Government or may impose conditions governing the equipment conveyed to the organization per the governing laws and regulations.

D.) Travel: Forecasts of travel expenditures (domestic and foreign) that identify the destination and the various cost elements (airfare, mileage, per diem rates, etc.) must be submitted. The costs should be in sufficient detail to determine the reasonableness of such costs. Allowance for air travel normally will not exceed the cost of round-trip, economy air accommodations. Specify the type of travel and its relationship to the research project. Requests for domestic travel must not exceed $3,000 per year per principal investigator. Separate, prior approval by the ARL is required for all foreign travel (i.e., travel outside the continental U.S., its possessions and Canada). Foreign travel requests must not exceed $1,800 each per year per principal investigator. Special justification will be required for travel requests

in excess of the amounts stated above and for travel by individuals other than the principal investigator(s). Individuals other than the principal investigator(s) are considered postdoctoral associates, research associates, graduate and undergraduate students, secretarial, clerical, and other technical personnel. Additional travel may be requested for travel to Army laboratories and facilities to enhance agreement objectives and to achieve technology transfer.

E.) Participant Support Costs: This budget category refers to costs of transportation, per diem, stipends, and other related costs for participants or trainees (but not employees) in connection with ARL-sponsored conferences, meetings, symposia, training activities, and workshops (see the "Other Programs" section as described earlier in this BAA). Generally, indirect costs are not allowed on participant support costs. The number of participants to be supported should be entered in the parentheses on the budget form. These costs should also be justified in the budget justification page(s) attached to the cost proposal.

F.) Materials, Supplies, and Consumables: A general description and total estimated cost of expendable equipment and supplies are required. The basis for developing the cost estimate (vendor quotes, invoice prices, engineering estimate, purchase order history, etc.) must be included. If possible, provide a material list.

G.) Publication, Documentation, and Dissemination: The budget may request funds for the costs of preparing, publishing, or otherwise making available to others the findings and products of the work conducted under an agreement, including costs of reports, reprints, page charges, or other journal costs (except costs for prior or early publication); necessary illustrations, cleanup, documentation, storage, and indexing of data and databases; and development, documentation, and debugging of software.

H.) Consultant Costs: Offerors normally are expected to utilize the services of their own staff to the maximum extent possible in managing and performing the project's effort. If the need for consultant services is anticipated, the nature of proposed consultant services should be justified and included in the technical proposal narrative. The cost proposal should include the names of consultant(s), primary organizational affiliation, each individual's expertise, daily compensation rate, number of days of expected service, and estimated travel and per diem costs.

I.) Computer Services: The cost of computer services, including computer-based retrieval of scientific, technical, and educational information, may be requested. A justification/explanation based on the established computer service rates at the proposing organization should be included. The budget also may request costs, which must be shown to be reasonable, for leasing automatic data processing equipment. The purchase of computers or associated hardware and software should be requested as items of equipment.

J.) Subawards (subcontracts or subgrants): A precise description of services or materials that are to be awarded by a subaward must be provided. For subawards totaling $10,000 or more, provide the following specific information:

1) A clear description of the work to be performed.
2) If known, the identification of the proposed subawardee and an explanation of why and how the subawardee was selected or will be selected.
3) The identification of the type of award to be used (cost reimbursement, fixed price, etc.).
4) Whether or not the award will be competitive and, if noncompetitive, rationale to

justify the absence of competition.

5) A detailed cost summary.

K.) Other Direct Costs: Itemize and provide the basis for proposed costs for other anticipated direct costs such as communications, transportation, insurance, and rental of equipment other than computer related items. Unusual or expensive items shall be fully explained and justified.

L.) Profit/ Fee: Profit/ fee is not allowed for the Recipient of or subaward to an assistance instrument, where the principal purpose of the activity to be carried out is to stimulate or support a public purpose (i.e., to provide assistance), rather than acquisition (i.e., to acquire goods and services for the direct benefit of the United States Government). A subaward is an award of financial assistance in the form of money, or property in lieu of money, made under a DoD grant or cooperative agreement by a recipient to an eligible subrecipient. The term includes financial assistance for substantive program performance by the subrecipient of a portion of the program for which the DoD grant or cooperative agreement was made. It does not include the recipient's procurement of goods and services needed to carry out the program.

M.) Subcontracting Plan: Subcontracting plans do not apply to assistance instruments.

CONTRACT FACILITIES CAPITAL COST OF MONEY: If cost of money is proposed, a completed Contract Facilities Capital Cost of Money (FCCM) (DD Form 1861) is required.

III. Appendix A: Proposal Instructions for Incorporating Unique Government Capabilities

The Offeror seeking unique government capabilities must, within the proposal, (a) identify and describe the equipment(s) and/or service(s) and their purpose(s), (b) identify the FFRDC(s), UARC(s), and/or OGA(s) providing such capabilities, and (c) identify a point-of-contact (POC) at the relevant FFRDC, UARC, or OGA for each capability sought. By way of appendices to the proposal, statements from FFRDC(s), UARC(s), and/or OGA(s) indicating the feasibility/availability of the requested capability and delivery schedule must be included and signed by the POC. The Offeror must also include in the proposal a risk mitigation strategy in the event the requested unique Government capability is not provisioned.