

DEVCOM Army Research Laboratory
BROAD AGENCY ANNOUNCEMENT FOR
FOUNDATIONS OF SUPERCONDUCTING DIGITAL LOGIC
(FSDL)



W911NF-23-S-0012

Issued by:

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I. OVERVIEW OF THE FUNDING OPPORTUNITY:

A. Required Overview Content

1. Federal Agency Name(s):

DEVCOM Army Research Laboratory – Army Research Office

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

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White Papers: 4:00 PM Eastern Daylight Savings Time on: 15 August 2023

Proposals: 4:00 PM Eastern Daylight Savings Time on: 31 October 2023

See Section II. D. 4 for additional information.

B. Additional Overview Information

This Broad Agency Announcement (BAA) which sets forth research areas of interest to the DEVCOM Army Research Laboratory- Army Research Office (ARL-ARO) and the National Security Agency (NSA) is issued under paragraph 6.102(d)(2) of the Federal Acquisition Regulation (FAR), and 10 U.S.C. 4001, 10 U.S.C. 4021, and 10 U.S.C. 4022 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 agencies involved in this program reserve the right to select for award; 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.

II. DETAILED INFORMATION ABOUT THE FUNDING OPPORTUNITY

A. Funding Opportunity Description

DEVCOM Army Research Laboratory - Army Research Office (ARL-ARO), in collaboration with the Laboratory for Physical Sciences (LPS), is soliciting proposals for foundational research in superconducting electronics (SCE). SCE is a promising technology for high-speed and energy-efficient digital circuits, but scaling towards denser and more reliable systems has been slow. The goal of the Foundations of Superconducting Digital Logic (FSDL) program is to uncover foundational issues limiting the progress of this technology and to pursue innovative research into overcoming these issues across topics such as materials, Josephson junctions, flux trapping, and architecture. FSDL aims to provide the foundation to enable breakthroughs in circuit density and reliability for future SCE-based systems.

A.1 Background and Overview of FSDL

Circuitry based on superconducting wires and Josephson junctions has the potential to yield energy-efficient and/or high-speed computing devices across many applications if certain scaling issues can be addressed [1][2]. The switching energy of the Josephson junction, approximately $2e^{-19}$ J, is well below that of transistor-based devices, and superconducting wires offer low-dissipation and low-dispersion interconnects, the lack of which constrain VLSI designs using normal metals. The most well-known application for SCE has been general-purpose computing as a replacement for semiconductor-based data centers [3][4], but other applications include neuromorphic computing [5][6], digital receivers with high-speed analog-to-digital converters and digital signal processing [7][8], and ultra-low power readout electronics for cryogenic sensors/systems such as transition edge sensors, microcalorimeters [9][10][11], and quantum computing [12][13][14]. Additionally, space and satellite technology, where low-power and radiation-hardened designs are valued [15][16], is a potential application, especially given advances in cryogenics for satellites [17].

For many of these applications to become feasible, it is necessary to increase both the density and reliability of SCE. Superconducting circuit density is limited by, among other factors, the geometric inductance required to store flux quanta, shunt resistors for Josephson junctions, minimum niobium line widths, and wide low-impedance transmission lines. Component counts for SCE designs are often dominated by ancillary devices such as clock and bias distribution, Josephson Transmission Lines (JTL), splitter trees for fanout, and buffer cells. Superconducting-memory is far less dense than its CMOS counterpart, constraining memory-intensive applications. The reliability of SCE is limited by issues such as flux trapping and process-stabilization. Flux trapping is a superconductivity-specific issue that could be exacerbated at higher densities, and SCE fabrication processes are unable to utilize process-stabilization techniques developed for CMOS due to temperature limitations imposed by Nb/Al-AIO_x/Nb junctions and niobium contamination.

The FSDL program goal is to provide the scientific foundation to overcome the challenges mentioned above. Hence, FSDL is soliciting proposals to study the foundational issues on topics such as materials, Josephson junctions, flux-trapping mitigations, and architectures used for SCE and to explore high-risk yet potentially revolutionary paths forward. The goal is not to produce near-term incremental gains but rather to unambiguously identify the underlying limiting factors and determine

the fundamental changes required for both an order-of-magnitude, or more, increase in circuit density as well as reliable fabrication and operation. The program encourages research compatible with future scaling towards complex, dense and practical circuits. Here, “complex” means that the circuit reliably performs computations of meaningful scope, volume, and throughput for the intended application, and “practical” refers to the satisfaction of implementation constraints such as limited I/O ports, bi-directional routing, multiple routing layers and ground planes, and distribution of clock and bias. Such future circuits will have requirements beyond those of simple repetitive diagnostic devices such as shift registers and ring oscillators. The FSDL program anticipates the complexity and density of future circuits and solicits proposals for research that will ultimately result in dense, complex, and reliable superconducting circuits.

A.2 Research Areas

While FSDL is broadly soliciting proposals on foundational aspects of SCE, the following four research areas are of particular interest to this BAA. For context and background, the following sections describe both the state of the practice (SOTP) for each research area and several technical challenges limiting progress towards higher density and reliability. The ordering of these four technology areas is not indicative of the relative priority the FSDL program places on them. Research that cannot be categorized neatly into one research area will be considered, and research addressing technical challenges that are not described below will also be considered if well motivated by the need to increase the density and reliability of SCE.

A.2.1 Novel Materials and Processing Techniques

A.2.1.1 State of the Practice:

SCE fabrication generally involves sputter deposition of niobium thin films, typically around 200 nm thick, followed by patterning with typical line widths down to 200-250 nm. This niobium film thickness exceeds the London penetration depth, and the incomplete penetration means the inductance per length of patterned lines is less susceptible to variations in film thickness and line widths. These niobium layers are stacked with SiO_x as the dielectric and generally require deposition temperatures less than 180° C to minimize niobium contamination and to preserve the quality of Nb/Al-AlO_x/Nb junctions (discussed in Section A.3.2).

The niobium film is patterned to form inductors, transformers, passive transmission lines, and vias, each with differing constraints on their size and density. Inductors must have a minimum inductance value to store a magnetic flux quantum; this value is fixed by the junction critical current, which itself is often bounded from below by error-rate requirements for each application. This minimum inductance is typically obtained by simply making inductors long rather than utilizing high-kinetic-inductance (KI) techniques. Line spacing is set by device tolerance to parasitic mutual inductance. Transformers couple only by geometric mutual inductance and must also be of sufficient length to obtain the required coupling. Passive transmission lines (PTLs) must interface with low-impedance SCE and thus have a low characteristic impedance of 20 ohms or less, obtained with relatively wide signals lines in the range of 5-10 um. Vias are typically fabricated with large aspect ratios to minimize voids in the sputtered niobium and are not stackable.

A.2.1.2 Technical Challenges:

Many limitations arise from undesirable material properties of sputtered niobium:

- Sputtered niobium forms columnar grains that can promote the formation of voids and defects and can interfere with damascene processing or fabricating lower-aspect-ratio vias, especially as feature sizes are reduced. Grains may also act as vortex pinning sites.
- Niobium film surfaces can be rough, interfering with fabricating uniform junctions and increasing variance in film thickness.
- Niobium-film stress can be large, can change from tensile to compressive, and can change with subsequent processing steps. Stress has been linked to variation in superconducting properties and must be monitored and controlled at increased layer count to avoid accumulated topography.
- Above 200° C, niobium readily absorbs low-atomic-number materials that can influence its superconducting properties. Such variable superconducting properties may influence flux trapping, as altered T_c due to subsequent processing can influence the T_c -sequencing of the layers.

Reducing the physical size of inductors will likely require moving to the high-kinetic-inductance (KI) regime where the London penetration depth exceeds one or both line dimensions. This could be accomplished by decreasing the thickness and/or line width for niobium below 200 nm or by using a high-KI material whose penetration depth exceeds 200 nm. However, both approaches will introduce challenges around accurate and consistent inductance targeting while maintaining sufficient critical current. At smaller line dimensions, existing variance in film thickness and lithography will have a larger fractional effect, and oxide layers will occupy a larger fraction of the superconductor cross-section and have a larger influence. Use of high-KI materials [18][19] is a well-known technique for reducing inductor size, but such materials have not yet been incorporated in a multi-layer stack-up. Fabrication variance will again influence inductance targeting but with the additional complication of stoichiometry control for consistent penetration depth and coherence length. The higher T_c of a high-KI material for wiring layer relative to niobium ground planes is a potential disadvantage in terms of flux trapping, and using high-KI materials for ground planes may reduce shielding.

Transformers are used extensively in AC-biased logic, but there is no clear path to reduce their size. Reducing line widths may allow for closer spacing of the primary and secondary coils but carries the same risks mentioned above. A soft high-permeability magnetic material compatible with thin-film processing has not yet been identified but would open new possibilities. Cryogenic capacitor materials could enable transformers to be replaced by capacitive coupling [20], but these capacitive materials would themselves need to be developed and integrated.

PTLs enable a unique feature of superconductivity: long-distance low-dispersion interconnects. However, PTLs currently use very wide line widths to achieve low characteristic impedance. Techniques to lower the inductance per length, or increase the capacitance per length, that are compatible with thin-film SCE fabrication would be needed to increase PTL density.

Improvements to dielectric deposition are known at deposition temperatures above 400° C, but incorporating such techniques is difficult given niobium's permeability to contaminants at temperatures above 200° C. AC-biased logic can have substantial AC losses of clock power in the dielectric. Variations in dielectric quality across the chip or wafer will impact PTL properties and uniformity.

FSDL encourages proposals focused on developing novel superconducting material, dielectrics and/or processing techniques to meet the above challenges or other relevant challenges in materials and processing.

A.2.1.3 Out-of-Scope Topics in Novel Materials and Processing Techniques

- Materials incompatible with multilayered fabrication;
- High T_c superconducting materials;
- Superconducting materials with T_c significantly lower than 4K.

A.2.2 Josephson Junction Research

A.2.2.1 State of the Practice

The Nb/Al-AIO_x/Nb trilayer junction is the widely accepted state-of-the-practice junction for digital applications due to its large critical current, fast switching speed, high yield, and high uniformity. After base niobium electrodes are patterned, a layer of aluminum is deposited and exposed to oxygen to form a very thin oxide layer, on the order of 10 angstroms. The oxidation step is carefully controlled as the critical current density depends exponentially on the oxide thickness. The aluminum layer is also thought to reduce the barrier roughness caused by the underlying niobium. External and relatively large shunt resistors are incorporated to make these junctions non-hysteretic. Once these junctions are fabricated, all subsequent processing steps are limited to temperatures below 180° C to preserve the AIO_x barrier. State-of-the-practice multi-layer SCE processes are dominated by Nb/Al-AIO_x/Nb junctions despite a large number of publications and proof-of-concept demonstrations of alternative Josephson junction technologies serving a wide variety of functions beyond digital switching.

A.2.2.2 Technical Challenges

Reducing the size of the shunt resistor, or eliminating it by developing self-shunted junctions, could improve circuit density by up to an order of magnitude [24]. Self-shunted junctions have been fabricated by thinning the oxide layer. However, this can cause the cross wafer spread to more than double [25]. Possible explanations include variation in the oxide thickness, surface variance due to the rough niobium electrode, and the formation of pinhole defects. Beyond reducing fabrication spread, the impact of internal heat and quasiparticle generation of a self-shunted Nb/Al-AIO_x/Nb needs to be explored.

Nb/Al-AIO_x/Nb junctions cannot be processed above 180° C due to oxygen migrating from the barrier to the niobium electrodes. This means that improved dielectric processing at 400° C or above is not feasible for SCE fabrication. It also generally constrains junctions to the top of the stack.

Many junction types have been explored [28][29] to overcome these challenges, and many materials have been tried such as Nb/TaN [30], NbN/TaN [31], NbTiN/AlN [32], NbN/MgO, Nb silicide [33], and Mo-Re/ α Si [34]. However, it is challenging to engineer junctions with sufficient critical currents or characteristic voltages for most digital applications. Other challenges include spread and targeting of critical currents at scale, reverse proximity effects, thermal stability, diffusion through interfaces, sensitivity to stoichiometry [27], and the ability to integrate materials into a multi-layer stack [31].

Of potential interest are junctions that can make specific circuits denser by providing, in a smaller area, functionality currently implemented by other devices. Pi junctions have been used in place of inverting transformers or DC bias [35] and could replace the inductance needed to store single flux quanta (SFQ) [23]. Spin-valve junctions can store energy states and act as superconducting memory cells [21] [36] [37]. Three-terminal junctions could serve as circuit control [22], and superconducting ferromagnetic transistors can be used for programmable logic or readout [38]. Despite the range of potential functionality, at-scale utilization of such junctions remains sparse to-date. Known scaling challenges for junctions utilizing relatively thick layers of magnetic materials include fabrication spread, initializing the magnetization state, large control currents needed to switch the magnetic state, and concerns over contaminating sensitive SFQ-based circuits with magnetic materials.

FSDL encourages proposals focused on developing novel Josephson junction technology, retaining the advantages of Nb/Al-AlO_x/Nb junctions, but overcoming the above identified challenges and/or introducing new functionality without degradation of other performance parameters.

A.2.2.3 Out-of-Scope Topics in Josephson Junction Research

- Junctions not amenable to multi-layer processing.
- Junctions with inherently large critical-current spreads, above roughly 3%.
- Switching junctions with $I_c R_n$ products below 0.2 mV.
- Junctions designed for ultra-cold (millikelvin) applications.
- Switching junctions with critical currents below 10 uA without strong additional motivation.
- Alternate logic elements meant to replace the Josephson junction.

A.2.3 Flux Trapping Research

A.2.3.1 State of the Practice

Flux trapping is one of the most pernicious failure modes of SCE, as its impact on circuit margins varies with cool downs, test setups, designs, and fabrication runs. In fact, any change in circuit operation or margins between thermal cycles is often attributed to flux trapping, and it is often assumed that the failure mode is vortex pinning outside a moat. To reduce the probability of this occurring, the community uses a combination of magnetic shielding, slow cool downs, optimized moat layout, and circuit design. Identification of pinned vortices can be achieved with a Scanning SQUID Microscope (SSM) in a dedicated machine on an inactive chip. Specialized electrical characterization techniques, such as bit-by-bit analysis of shift registers, are sometimes employed to extract local margin data.

A.2.3.2 Technical Challenges

While present-day mitigation schemes may be sufficient for moderately complex circuits to function reliably, they will likely not scale with either circuit size or density. In fact, despite years of work fine tuning the mitigation framework described above, flux trapping continues to be cited as a present-day impediment. Meanwhile, convincing demonstrations of the exact nature of intermittent failure modes of complex circuits fabricated in a multi-layer stack-up and operated in typical magnetic shielding with sufficient statistics are lacking. An SSM can detect vortices pinned outside moats but cannot correlate them to degraded margins, and gathering sufficient statistics is challenging. Electrical characterization, such as bit-by-bit margin analysis, can detect degraded margins in individual cells but cannot directly correlate them to stray flux. Hardware-to-model correlation could be greatly

improved. For example, models of fluxon dynamics and formation during the superconducting transition do not currently predict flux pinning sites with high probability, even in simple designs. Bridging this gap between vortex identification and circuit performance is of interest to the FSDL program.

Additional research is needed to understand the role of other potential failure modes. Flux and persistent-current distributions below the top ground plane are difficult to measure and may interfere with circuit operation. Thermal fluctuations during transition can generate fluxons in inductive loops [39] or vortex/anti-vortex pairs in thin films [40]. However, such phenomena are challenging to identify without in-situ diagnosis and/or advanced magnetic imaging. Furthermore, thermal activations have been studied in the context of thin films or single-degree-of-freedom loops but not in complex circuits with many degrees of freedom nor as a function of circuit density. Other possible failure modes that do not involve flux include cosmic-ray impacts, electromagnetic interference, and unintended shorts or open connections created during cool down due to ice, thermal expansion, or material growth.

Another impediment is the low SSM throughput, which makes high-statistics magnetic-imaging studies time consuming. For example, a 5 x 5 mm² chip with over 100 flux quanta might take several days to image completely. While an applied field can increase fluxon density for better statistics, such studies do not necessarily correlate to the low-field best practices [42], and it is instead preferred to increase the instrument throughput to study chips in typical shielding (< 100 nT). Increasing imaging speed is also desired to study flux dynamics during the superconducting transition.

FSDL encourages research in scalable solutions to flux trapping, provided the relevant failure modes have been unambiguously identified. Novel approaches may include passive schemes such as critical-temperature gradients, more advanced shielding, and novel ground plane designs as well as techniques for actively removing flux such as thermal gradients or optical control [41]. Detailed characterization of the influence of the solution on flux trapping is required.

A.2.3.3 Out-of-Scope Topics in Flux Trapping Research

- High magnetic field imagery for validation.
- Experiments that cannot demonstrate statistical significance, e.g., because the failure modes are intrinsically intermittent.
- Vortex dynamic studies in materials without direct application to SCE, unless the results can be reasonably extrapolated to relevant stack ups.

A.2.4 Improvements in Logic & Architecture

A.2.4.1 State of the Practice

There are three predominant logic families within SCE: Rapid Single Flux Quanta (RSFQ) and its energy-efficient variants, adiabatic Quantum Flux Parametron (AQFP), and Reciprocal Quantum Logic (RQL). RSFQ is a DC-biased logic, and every RSFQ gate must generally be clocked to compute the output and reset the gate. RSFQ has obtained the fastest operating circuits. For both AQFP and RQL, the functions of current bias and clock are mostly combined into one or more AC signals. The largest circuits to-date have been AC-biased. Neither AQFP nor RQL requires an explicit gate reset.

Memory for superconducting digital logic has been successfully implemented with conventional junctions using address/bit lines with both active [49] and passive [50] signaling. Non-Destructive Read Out memory has achieved a density of 0.23 Mb/cm^2 with 2.5 routable layers and 5 kA junctions [49]. Passive memories, such as Vortex Transition memory (VT-RAM), achieved a density of 0.88 Mb/cm^2 using 60 kA/cm^2 self-shunted junctions [50]. VT-RAM has demonstrated a 4-kb memory block dissipating 9.5 mW with an access time of 380 ps that was essentially propagation delay [51]. The densities of these memory types strongly influence available processor architectures.

A.2.4.2 Technical Challenges

The scaling issues of DC biasing are well known – parallel biasing is limited to 20,000 – 30,000 Josephson junctions [24] and can degrade bias margins due to fields from the feed current [43]. Serial biasing techniques [44] require interface circuitry with its own biasing, possibly reducing density, while making signal transfer between the serially biased islands difficult [45]. It is not clear that such techniques can be extended to bias over one million junctions per chip. RSFQ gates typically require a clock pulse to output the logic and reset the gate. This clocking requirement effectively creates deep pipelines that are undesirable for processor architecture, burden static timing analysis, and reduce the effective or logical clock rate. Significant effort must be made in VLSI RSFQ designs to ensure the clock pulse co-propagates with the data. The large clock distribution network, in addition to the energy-efficient biasing network, adds significantly to overhead.

AC-biased logic does not require large bias currents but does require extensive power transmission lines and transformers [24]. There is no clear path to reduce transformer size [24], and crosstalk between transformers will worsen at higher densities [46]. High-speed operation of AC-biased circuits may be limited by clock skew [47] and AC losses in the dielectric. To-date, AC-biased circuits have not matched RSFQ-based circuits in clock speed. AC-biased logic families can utilize multiple clock phases to perform more logic per cycle, but this introduces additional timing complications and may not yield a logical clock rate greatly exceeding CMOS designs.

In VLSI designs, a large fraction of the total junction count comes from ancillary components such as splitters, buffers, JTLs, drivers/receivers for PTLs, and logic-to-memory interfaces, all of which consume power, occupy space, introduce delay, and increase the sites for potentially fatal fabrication defects. This overhead is tolerable at lower integration scales but will increasingly limit high-scale integration. JTL signal reach is limited due to inflexible inductor values and consumes power. PTLs enable long-distance transmission but require large driver and receiver circuits, are very wide, and do not address fanout challenges. Fanout is a costly operation for SCE in terms of delay and overhead in extra components that could be optimized [54]. Buffers are required for timing and path balancing and perhaps could be reduced in number with new approaches to clocking.

A long-standing technical challenge in SCE architecture is the fact that, despite impressive metrics for access time and power dissipation, superconducting memory is far less dense than CMOS-based memory. CMOS SRAM memory with a feature size of 250 nm, comparable to SCE feature sizes, achieves roughly 20 Mb/cm^2 [52]. At a 22-nm feature size, CMOS memory densities can exceed 1000 Mb/cm^2 [53]. Superconducting memory based on magnetic junctions [21] has been attempted but suffers from the issues discussed in Section A.2.3. Combining cryogenic CMOS and SCE technologies could allow one to combine the memory density of CMOS and logical speed of SCE, but signal conversion is a challenge that could offset the power advantage of SCE.

SCE could benefit substantially from architectures that are tailored to the strengths (low loss interconnects, high clock speed) and weaknesses (low memory density, lack of fanout, lack of multiport memory) of SCE. Many superconducting-processor designs are predicated on CMOS-based designs, which evolved over the era of Moore's Law and capitalized on rapidly decreasing transistor sizes and the concomitant increases in speed, density, and power efficiency. SCE could instead benefit from architectures that emphasize economy of on-chip memory and incorporate off-chip memory, leveraging superconducting interconnects through multi-chip modules or chip stacking. Innovative approaches to address the lack of multiport register files, which support multiple in-flight instructions and avoid processor stalling [55], are also desired.

A.2.4.3 Out-of-Scope Topics in Improvements in Logic & Architecture

- Designs for single memory cells that do not have promise to scale.
- Previously attempted memory array without a novel approach or an approach that can yield only incremental gains in density.
- Novel logic with no plans for hardware implementation or whose development path will not yield densities and complexities of interest within the program duration.
- Gate designs for incremental progress.
- Superconducting implementation of known hardware not motivated by a target application.
- Variations of component design that promise only marginal increases in density.

A.3 Proposal Categories

The FSDL program will consider two categories of proposals: those for exploratory projects and those for integrated projects. Further details and proposal requirements for each category are described in detail below.

A.3.1 Proposals for Exploratory Projects

Proposals for Exploratory Projects are 4-year-long proof-of-concept efforts for novel research to address one or more technical challenges faced by SCE, such as those discussed in Section A.2. The yearly goals of these Exploratory Proposals are in the following list. The yearly breakdown below should be taken as rough guidance; proposals may vary the rate of achievement of goals, provided the final goal is reached by Year 4:

1. Years 0-1: Definitively identify the physical causes of the targeted technical challenges with supporting experimentation, theory, and/or simulation.
2. Years 1-3: Perform convincing "proof-of-concept" demonstrations of the solution(s) to overcome the identified challenges using an appropriate combination of experiments, theory, and/or simulation.
3. Years 3-4: Project whether the technique(s) developed is applicable to large-scale circuits and whether or not a clear pathway to improved density and reliability is possible. This may involve further demonstrations, theory, simulation, and/or working with GFR fabrication partners (see Section A5).

Exploratory Projects are not required to integrate technological advancements into an established state-of-the-art multilayer stack-up, but proposals must discuss how the planned approaches would be compatible with such multilayer stack-ups. The intention is to encourage novel approaches and exploratory research without incurring the cost, complexity, and time required for integration.

Proposals for Exploratory Projects are expected to incorporate the following information:

- Carefully consider the application space of SCE and motivate their work based on one or more of these applications; refer to Section A.4.
- Identify application-specific metrics, including density and reliability, and describe the state of the art for each metric. Proposals will outline yearly measurable milestones based on these metrics, evaluating the progress of the research towards proof-of-concept demonstrations. The capabilities for each target application that may be enabled upon successful achievement of the defined milestones shall be described.
- Demonstration circuits, test articles, and/or numerical simulations of sufficient scale to demonstrate proof-of-concept compatible with the identified target application.
- Experimental approaches, associated theory, and/or simulation work that cleanly isolate known failure modes, such as trapped flux or fabrication variance, from issues that may be introduced by the new technology.
- Identify all necessary skills and experience needed to successfully execute the research project. Proposals involving multiple investigators shall describe how those skills are distributed across the team and how research tasks will be divided amongst the proposing team. For example, for proposals with hardware demonstrations, describe where the testing will be done, who will do the testing, required test stands and equipment, and configuration management. If funded, throughout the period-of-performance of the project, performers should be prepared to provide sufficient details of their testing to the FSDL program management team to enable an independent team to reproduce their results.
- Identify the technical challenges associated with the proposed approach, especially with respect to density and reliability.

A.3.2 Proposals for Integration Projects

Proposals for Integration Projects are expected to describe a 5-year-long research plan to incorporate novel approaches, for which proof of concept has already been demonstrated, with supporting documentation. Proposals for Integration Projects are expected to describe how these novel approaches will be implemented in a new multi-layer process with the goal of demonstrating the utility of the novel approaches in a complex, dense, and practical circuit (see third paragraph of Section A1). Here, “novel approaches” means technologies or techniques to solve one or more of the technical challenges of scaling SCE, such as those listed in Section A.2, and “novel” means the approach is new to multi-layer stack-ups for SCE, even if the approach has been established in other applications. “Proof of concept” means that the novel approach must have some degree of prior demonstration, either from the literature or from previous work from the proposing team. While innovations are encouraged, a balance must be struck between the risks introduced by the novel approaches, their unintended side-effects and the potential advances offered. Furthermore, while the end goal is to demonstrate a sufficiently complex integrated circuit, proposals must nonetheless emphasize the fundamental issues to be uncovered and challenges to be overcome within the technology under scrutiny.

The yearly goals of these Integration Proposals are in the following list. The yearly breakdown below should be taken as rough guidance to proposing teams; proposals may vary the rate of achievement of goals, provided the final goal is reached by Year 5:

1. Years 0-1: Teams must show that the novel approaches that address one or more technical challenges faced by SCE, such as those described in Section A.2. This may involve some

- early demonstrations involving experiments, theory and/or simulation to validate the selected approaches beyond the proof of concept referenced in the proposal.
2. Years 1-4: Teams must incorporate the novel approaches into a multi-layer stack-up capable of supporting dense and/or more reliable circuits. Any unintended side-effects must be assessed after incorporation into the stack-up and implement mitigation plans should the side-effects compromise circuit yield or functionality.
 3. Years 4-5: Teams must implement their new stack-up to fabricate complex, dense, and practical integrated demonstration chips that fully leverage the novel approaches. This demonstration must prove that the targeted technical challenges have been overcome, thus delivering a device of higher density and reliability for the specific application in mind.

Proposals for Integration Projects are expected to incorporate the following information:

- Carefully consider the application space of SCE and describe a program of research aimed at one or more of these applications; refer to Section A.4.
- Identify application-specific metrics, including density and reliability, and describe the state of the art for each metric. Yearly measurable milestones based on these metrics must be described, evaluating the progress toward delivery of the integrated devices that illustrate the advantages of the chosen technology. The capabilities for each target application that may be enabled upon successful achievement of the defined milestones must be described.
- Include an overarching integration plan that assesses the novel approaches individually and outlines decision points for each integration step into the modified multilayer stack-up. Decision points define individual deadlines for deciding whether or not to incorporate each novel approach in the new stack-up based on progress towards milestones. Proposals are expected to identify contingency plans should the integration of any proposed novel approach prove intractable.
- Identify any new fabrication techniques or supporting technologies required by their stack-up, including new tooling. These may include established techniques and technologies that are new to the proposing team.
- A series of demonstration circuits and/or test articles aimed at showing functionality, advantages, and challenges associated with the novel approaches. Later demonstrations are expected to be aimed at supporting the identified target application.
- Outline experimental plans, associated theory and/or simulation work that cleanly isolates known failure modes, such as trapped flux or fabrication variance, from issues that may be introduced by the novel approaches.
- Identify all necessary skills and experience needed to successfully execute the research project, how those skills are distributed across the team, and how research tasks will be divided amongst the team. For example, proposals are expected to describe where the testing will be done, who will do the testing, required test stands and equipment, and configuration management. If funded, throughout the period-of-performance of the project, performers are expected to be prepared to provide sufficient details of their testing to the FSDL program management team to allow an independent team to reproduce their results.
- Identify the technical challenges associated with the proposed approach, especially with respect to density and/or reliability.

A.4 Target Applications Discussion

The FSDL program will consider proposals for foundational research that may have relevance across a wide range of applications. While direct pursuit of applications other than those described herein is

out-of-scope for this BAA, proposals shall include a discussion of the range of possible applications the planned research may enable. Emerging applications may be considered alongside more traditional applications such as general-purpose computing. However, proposals with relevance to emerging applications must focus on scaling issues. Applications in superconducting general-purpose computing typically require developing dense superconducting memory. However, significant advances can be made in other applications ahead of or in parallel with advances in superconducting memory; neuromorphic computing and digital signal processing are possible examples of such memory-light applications. Just as CMOS designers are developing specialized hardware accelerators as the limit of Moore's Law is approached [56], so might SCE find applications for specialized energy-efficient or high-throughput computational devices.

A.5 Government Furnished Resources

For Exploratory Projects, the FSDL program intends to provide access to an established multi-layer fabrication process when appropriate. There may also be limited availability to incorporate new technologies, developed within projects funded by this BAA, into this established process.

The FSDL program is considering providing limited SSM services to performers. The availability and capabilities have not yet been determined and may not be sufficient for all proposed technical approaches. It is advised that white papers include a discussion of the impact such a service could have on the proposed research as well as contingency planning should the SSM service not be available.

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B. Federal Award Information

Anticipated awards will be made in the form of procurement contracts, grants, or cooperative agreements, 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 primarily 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. 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>

5. 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>

6. 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
- d. 2 CFR part 1104.
- e. 32 CFR Parts 21, 22, 26, and 28.
- f. DoD R&D General Terms and Conditions.
- g. Agency Specific Research Terms and Conditions

7. Grants and cooperative agreements for for-profit and nonprofit organizations exempted from Subpart E—Cost Principles of 2 CFR Part 200, are primarily governed by the following:

- a. Federal statutes.
- b. Federal regulations.
- c. 32 CFR Part 34 – Administrative Requirements for Grants and Agreements with For-Profit Organizations
- d. 32 CFR Parts 21, 22, 26, and 28
- e. DoD Research and Development General Terms and Conditions
- f. Agency-specific Research Terms and Conditions

8. OTs for Research

Legal instruments which are primarily governed by the following:

- a. Federal statutes
- b. Federal regulations
- c. 32 CFR Part 37 – Technology Investment Agreements
- d. DoD Research and Development General Terms and Conditions
- e. Agency-specific Research Terms and Conditions
- f. Office of Secretary of Defense implementation guidance titled Other Transactions (OT) Guide for Research Projects (November 2018, Version 1)

9. OTs for Prototypes or Production

Legal instruments which are primarily governed by the following:

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

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.nre.navy.mil/work-with-us/manage-your-award/manage-grant-award/grants-terms-conditions>
- d. Agency-specific Research Terms and Conditions: <https://www.arl.army.mil/resources/baa-forms/#terms-and-conditions>

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. Federally Funded Research and Development Centers (FFRDCs):

Federally Funded Research & Development Centers (FFRDCs), including Department of Energy National Laboratories, are not eligible to receive awards under this BAA. However, teaming arrangements between FFRDCs and eligible principal offerors are allowed so long as such arrangements are permitted under the sponsoring agreement between the Government and the specific FFRDC, and no funds from the award flow to the FFRDC.

D. Application and Submission Information

1. Address to View Broad Agency Announcement

This BAA may be accessed from the following:

- 1) Grants.gov (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. Submission of a White Paper

White Papers – Prospective applicants **are strongly encouraged** to submit White Papers. The purpose of requesting a White Paper is to minimize the labor and cost associated

with the production of a detailed proposal that has very little chance of being selected for funding. Based on assessment of the White Papers, feedback will be provided to an applicant to enable that applicant to make a determination as to whether they should submit a proposal. If offerors have not submitted White Papers under the BAA, offerors may still submit full proposals for consideration for funding.

White Paper Format and Content:

- White Papers must be submitted electronically to usarmy.rtp.devcom-arl.mesg.qcbox@army.mil in the following format:
- Single PDF file as an email attachment
- Page Size: 8 ½ x 11 inches
- Margins – 1 inch
- Font – No smaller than Times New Roman, 12 point
- Number of Pages – no more than ten (10) single-sided pages. Any pages exceeding the ten-page limit will not be evaluated.

White Papers must contain the following:

- Title page. The title page should be labeled “FSDL BAA White Paper” and should include the BAA number, proposed title, program goal being addressed, Principal Investigator (PI) with telephone number and email address, and an executive summary. (Not to exceed one page.)
- Expected expenditures and justifications. (Not to exceed one page.)
- Curriculum vitae sketches. (Not to exceed one page.)
- Technical portion including all references and figures. Introduce the problem to be addressed, briefly survey related work, identify key obstacles, outline the proposed solution and well-defined objective, outline the yearly research plan with milestones, and state the impact if successful. (Not to exceed seven pages.)

c. Preparing a Proposal

After White Paper reviews are completed, interested offerors should submit proposals in accordance with the requirements set forth in this BAA.

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:

1. A Cover Page is required. For contract proposals submitted by email, use ARO Form 51. For all Assistance instruments and contract proposals submitted via Grants.gov, use the SF 424 (R&R) Form. Proposals will not be processed without either: (1) a signed Cover Page, ARO Form 51, or (2) a 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. 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] and implemented by 32 CFR 22.420(d), federal agencies shall obtain each awardees' Taxpayer Identification Number (TIN). 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.
7. Offerors must provide their organization's Unique Entity Identifier (UIE) (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.
8. Offerors must 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/>

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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 Section 8123 of the DoD Appropriations Act, 2015. The website address is <https://dodgrantawards.dtic.mil/grants>

PROJECT DESCRIPTION (TECHNICAL PROPOSAL): The technical portion of the proposal shall be no longer than 20 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 and well-defined objective. Proposals should describe an approach to all technical areas with unambiguous and quantitative milestones. Proposers must justify the utility of the proposed work and highlight its benefits over the current state of the art. Proposals should clearly address the expected key challenges and proposed methods to overcome these difficulties taking into consideration the current state of field. Proposers should set aggressive yearly quantitative milestones that define a path toward the end-of-the-program goals and analyze the impact if successful.

2. Project Schedule, Milestones, and Deliverables: A summary of the schedule of events, milestones, and a detailed description of the results and products to be delivered.
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 to 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 proposers is described in A.2.4.

BIOGRAPHICAL SKETCHES:

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

Nonprofit Organizations*: 2 CFR Part 200

Commercial Organizations: FAR Part 31, DFARS Part 231, FAR Subsection 15.403-5, and DFARS Subsection 215.403-5.

*For those nonprofit organizations specifically exempt from the provisions of Subpart E of 2 CFR Part 200 (see 2 CFR 200.401(c)), FAR Part 31 and DFARS Part 231 shall apply.

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.

- (1) To evaluate compliance with Title IX of the Education Amendments of 1972 (20

U.S.C. A Section 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.

(A) 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.

(B) 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 or 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.

(2) Data Management Plan: A data management plan is a document that describes which data generated through the course of the proposed research will be shared and preserved, how it will be done, or explains why data sharing or preservation is not possible or scientifically appropriate, or why the costs of sharing or preservation are incommensurate with the value of doing so. See also: DoD Instruction 3200.12. In no more than 2 pages set forth as a separate PDF document, discuss the following:

- The types of data, software, and other materials to be produced.
- How the data will be acquired.
- Time and location of data acquisition, if scientifically pertinent.
- How the data will be processed.
- The file formats and the naming conventions that will be used.
- A description of the quality assurance and quality control measures during collection, analysis, and processing.
- A description of dataset origin when existing data resources are used.
- A description of the standards to be used for data and metadata format and content.
- Appropriate timeframe for preservation.
- The plan may consider the balance between the relative value of data preservation and other factors such as the associated cost and administrative burden. The plan will provide a justification for such decisions.
- A statement that the data cannot be made available to the public when there are

national security or controlled unclassified information concerns (e.g., “This data cannot be cleared for public release in accordance with the requirements in DoD Directive 5230.09.”)

(3) With the application, the Applicant must provide the following “Privacy Act Statement” consent form for each Covered Individual in the proposal. This form must also be signed by the Applicant as that Individual’s Sponsor.

e. 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@mail.mil

Do not email full proposals to the 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>

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):

1) Proposals requesting Assistance agreements must be submitted via Grants.gov; proposals requesting a Contract or OT may be submitted either via Grants.gov or email (instructions above).

(2) Grants.gov Registration must be accomplished prior to application submission in Grants.gov.

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/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.

NOTE: All web links referenced in this section are subject to change by Grants.gov and may not be updated here.

(3) Specific forms are required for submission of a proposal. The forms are contained in the Application Package available at <http://www.grants.gov> under the specific opportunity you are submitting under. When viewing an opportunity, select the "Package" tab and then select "View." A Grant Application Package and Application Instructions are available for this BAA through the Grants.gov Apply portal under CFDA Number 12.431/Funding Opportunity Number W911NF-23-S-0012. To apply, select "Apply" and then "Apply Now Using Workspace."

*NOTE: Effective 31 December 2017, applicants must apply online at Grants.gov using the application Workspace. For access to complete instructions on how to apply for opportunities using Workspace refer to <https://www.grants.gov/web/grants/applicants/workspace-overview.html>

The following documents are mandatory: (1) Application for Federal Assistance (R&R) (SF 424 (R&R)), and (4) Attachments form.

(4) The SF 424 (R&R) form is to be used as the cover page for all proposals submitted via Grants.gov. The SF 424 (R&R) must be fully completed. AOR usernames and passwords serve as “electronic signatures” when your organization submits applications through Grants.gov. By using the SF 424 (R&R), proposers are providing the certification required by 32 CFR Part 28 regarding lobbying (see Section II.F.2.a.ii of this BAA). Block 11, “Descriptive Title of Applicant’s Project,” must reference the research topic area being addressed in the effort by identifying the specific paragraph from Section II.A of this BAA.

(5) The Attachments form must contain the documents outlined in Section II.D.2.e.ii entitled “Table of Contents”. All documents must be combined into separate and single PDF formatted files using the Table of Contents names. Include “W911NF-23-S-0012” in the title so the proposal will be distinguished from other BAA submissions and upload each document to the mandatory Attachments form.

(6) The applicant must include with its proposal submission the representations required by Section II.F.2.a.ii of this BAA. The representations must include applicant POC information and be signed by an authorized representative. Attach the representations document to an available field within the Attachments form. Note: If the applicant’s online SAM Representations and Certifications include its response to the representations, a hard copy representation is not required with proposal submission.

(7) The Grants.gov User Guide at:

<https://www.grants.gov/help/html/help/index.htm#t=GetStarted%2FGetStarted.htm> will assist AORs in the application process. Remember that you must open and complete the Application for Federal Assistance (R&R) (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”.

(8) 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.

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

a. 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) Provide a valid unique entity identifier (formerly DUNS) in its application. More information on the DUNS to Unique Entity ID (SAM) Transition can be found at <https://sam.gov/content/duns-uei>
- (ii) Be registered in SAM before submitting its application; and

(iii) 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.

b. The SAM obtains Legal Business Name, Doing Business Name (DBA), Physical Address, and Postal Code/ Zip+4 data fields from D&B. If corrections are required, registrants will not be able to enter/modify these fields in SAM; they will be pre-populated using D&B Unique Entity Identifier record data. When D&B confirms the correction has been made, the registrant must then re-visit sam.gov and click a “yes” to D&B's changes. Only at this point will the D&B data be accepted into the SAM record. Allow a minimum of two (2) business days for D&B to send the modified data to SAM.

c. 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:

White Papers:

White Papers must be submitted electronically via e-mail to usarmy.rtp.devcom-arl.mesg.qcbox@army.mil

and received at the Army Research Office **by 4:00 PM Eastern Time on 15 August 2023.**

The email subject line should contain the following: **W911NF-23-S-0012 FSDL White Paper.**

White Papers received after the deadline will not be reviewed. Feedback on the White Papers will be emailed directly to the proposed principal investigators by 12 September 2023.

Proposals:

Proposals transmitted to be considered for award must be received by Grants.gov **no later than 4:00 PM Eastern Time on 31 October 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. Per-project funding guidance is provided in the table below. Year 1 & 2 guidance is larger than Years 3-5 to provide the opportunity to set up experimental infrastructure for the proposed research early in the project, primarily in Year 1. Projects requesting the maximums, or larger, shown below must provide strong and justification based on the scope and complexity of the proposed research. Exploratory Projects shall be 3-4 years in durations; Integration Projects shall be 4-5 years.

Proposal Type	Year 1	Year 2	Year 3	Year 4	Year 5
Exploratory	\$3,000,000	\$2,250,000	\$2,000,000	\$2,000,000	0
Integration	\$7,000,000	\$5,000,000	\$4,000,000	\$4,000,000	\$4,000,000

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 this BAA 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 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 FSDL Program goals. The proposal describes how the proposed solution contributes to 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 Proposers 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 to achieving the objectives of the proposal. Time commitments of key personnel must be sufficient for their proposed responsibilities in the effort.

NOTE: Cost sharing will not be considered in the evaluation.

2. Review and Selection Process:

- a. 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.
- b. 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.
- c. 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.
- d. 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:

The Grants Officer is responsible for determining a recipient’s qualification prior to award. In general, a Grants Officer will award grants or cooperative agreements only to qualified recipients that meet the standards at 32 CFR 22.415. To be qualified, a potential recipient must:

- Have the management capability and adequate financial and technical resources, given those that would be made available through the grant or cooperative agreement, to execute the program of activities envisioned under the grant or cooperative agreement;
- Have a satisfactory record of executing such programs or activities (if a prior recipient of an award);
- Have a satisfactory record of integrity and business ethics; and
- Be otherwise qualified and eligible to receive a grant or cooperative agreement under applicable laws and regulations. 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 (FAPIS), or any successor system designated by OMB, concerning grants, cooperative agreements, and OTs 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 FAPIS) (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 CONTRACT Proposals:

i. Contracts shall be awarded to responsible prospective contractors only. See FAR 9.104-1 for a listing of the general standards against which an applicant will be assessed to determine responsibility.

Applicants are requested to provide information with proposal submission to assist the Contracting Officer's evaluation of responsibility.

ii. FAPIS will be checked prior to making an award. The web address is: SAM.gov The applicant representing the entity may comment in this system on any information about the entity that a federal government official entered. The information in FAPIS 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.

F. Award Administration Information:

1. Award Notices:

Initial notification of selection of proposals for funding will be e-mailed by ARL-ARO to successful offerors about 08 January 2024.

Applicants whose proposals are recommended for award may 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/or other information as applicable to the proposed award. The anticipated start date will be determined at that time.

The notification email is not an authorization to commit or expend funds. The Government is not obligated to provide any funding until a Government Contracting/ Grants Officer signs the award document.

The award document signed by the Government Contracting/Grants Officer is the official and authorizing award instrument. The authorizing award instrument, signed by the Contracting/ Grants Officer, will be emailed to the PI and AOR.

2. Administrative and National Policy Requirements:

a. Required Certifications

(i) For CONTRACT Proposals:

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>. DFARS 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)

(a) Definition. As used in this provision--

“Internal confidentiality agreement or statement”, “subcontract”, and “subcontractor”, are defined in the clause at 52.203-19, Prohibition on Requiring Certain Internal Confidentiality Agreements or Statements.

(b) In accordance with section 743 of Division E, Title VII, of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235) and its successor provisions in subsequent appropriations acts (and as extended in continuing resolutions), Government agencies are not permitted to use funds appropriated (or otherwise made available) for contracts with an entity that requires employees or subcontractors of such entity seeking to report waste, fraud, or abuse to sign internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or subcontractors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law

enforcement representative of a Federal department or agency authorized to receive such information.

(c) The prohibition in paragraph (b) of this provision does not contravene requirements applicable to SF 312, (Classified Information Nondisclosure Agreement), Form 4414 (Sensitive Compartmented Information Nondisclosure Agreement), or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

(d) Representation. By submission of its offer, the applicant represents that it will not require its employees or subcontractors to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or subcontractors from lawfully reporting waste, fraud, or abuse related to the performance of a Government contract to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information (e.g., agency Office of the Inspector General).

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.

FAR 52.204-27 PROHIBITION ON A BYTEDANCE COVERED APPLICATION (JUN 2023)

(a) Definitions. As used in this clause, "Covered application means the social networking service TikTok or any successor application or service developed or provided by ByteDance Limited or an entity owned by ByteDance" Limited. Information technology, as defined in 40 U.S.C. 11101(6)— (1) Means any equipment or interconnected system or subsystem of equipment, used in the automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency, if the equipment is used by the executive agency directly or is used by a contractor under a contract with the executive agency that requires the use— (i) Of that equipment; or (ii) Of that equipment to a significant extent in the performance of a service or the furnishing of a product; (2) Includes computers, ancillary equipment (including imaging peripherals, input, output, and storage devices necessary for security and surveillance), peripheral equipment designed to be controlled by the central processing unit of a computer, software, firmware and similar procedures, services (including

support services), and related resources; but (3) Does not include any equipment acquired by a Federal contractor incidental to a Federal contract.

(b) Prohibition. Section 102 of Division R of the Consolidated Appropriations Act, 2023 (Pub. L. 117-328), the No TikTok on Government Devices Act, and its implementing guidance under Office of Management and Budget (OMB) Memorandum M-23-13, dated February 27, 2023, “No TikTok on Government Devices” Implementation Guidance, collectively prohibit the presence or use of a covered application on executive agency information technology, including certain equipment used by Federal contractors. The Contractor is prohibited from having or using a covered application on any information technology owned or managed by the Government, or on any information technology used or provided by the Contractor under this contract, including equipment provided by the Contractor’s employees; however, this prohibition does not apply if the Contracting Officer provides written notification to the Contractor that an exception has been granted in accordance with OMB Memorandum M-23-13.

(c) Subcontracts. The Contractor shall insert the substance of this clause, including this paragraph (c), in all subcontracts, including subcontracts for the acquisition of commercial products or commercial services.

FAR 52.209-11, REPRESENTATION BY CORPORATIONS REGARDING DELINQUENT TAX LIABILITY OR A FELONY CONVICTION UNDER 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 applicant Offeror 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.

(ii) For GRANT and COOPERATIVE AGREEMENT Proposals:

(1) 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. When submitting your grant through Grants.gov, by completing blocks 18 and 19 of the SF 424 (R&R) Form, the grant applicant is providing the certification on lobbying required by 32 CFR Part 28; otherwise, a copy signed by the AOR must be provided. Below is the required certification:

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 SF-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 31 U.S.C. 1352. 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.

(2) In accordance with Section 743 of P.L. 113-235 , none of the funds appropriated or otherwise made available by that or any other Act may be made available for a grant or cooperative agreement with an entity that requires its employees or contractors seeking to report

fraud, waste, or abuse to sign internal confidentiality agreements or statements prohibiting or otherwise restricting those employees or contractors 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 the information.

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: Section 743 states that it does not contravene requirements applicable to SF 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

(3) Recipients are required to submit the following representation with the application package IAW the instructions at Section II.D.2.f.ii of this BAA:

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:

(a) 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.

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

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.

PROHIBITION ON CONTRACTING WITH ENTITIES USING CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT

Section 889 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2019 (Public Law 115-232) prohibits the head of an executive agency from obligating or expending loan or grant funds to procure or obtain, extend, or renew a contract to procure or obtain, or enter into a contract (or extend or 105 renew a contract) to procure or obtain the equipment, services, or systems prohibited systems as identified in section 889 of the NDAA for FY 2019. For more information on how this applies to all grant recipients and sub-recipients after August 13, 2020, please see DoD Research General Terms and Conditions (SEP 2021) NP Article IV. Other national policy requirements, paragraph 18.

b. Policy Requirements:

The following list provides notable national policy requirements that may be applicable to an award. NOTE: The following is not an all-inclusive list of policy requirements. For assistance awards, refer to the DoD Research and Development General Terms and Conditions at <https://www.onr.navy.mil/en/work-with-us/manage-your-award/manage-grant-award/grants-terms-conditions> for additional national policy requirements that may apply. For contract awards, appropriate clauses will be added to award documents.

i. PROTECTION OF HUMAN SUBJECTS:

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

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.

iii. BIOLOGICAL DEFENSE PROGRAM SAFETY 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>

iv. 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.

v. 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/>

vi. 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.fsr.gov>” cited in paragraphs a.2.i. and a.3 of the award provision is replaced by the phrase “<http://www.fsr.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.

3. Reporting:

a. Additional reports including number and types will be specified in the award document but will include as a minimum monthly 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. A final report that summarizes the project and tasks will be required at the conclusion of the performance period for the award.

b. 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>.

c. 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 2 CFR 200 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 Laboratory - 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.

1. CONTRACT Proposals:

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”, “SDB”, “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	TPOC 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-fee (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 proposer’s cognizant Defense Contract Management Agency (DCMA) administration office (if known)
14	Name, address, and telephone number of the proposer’s cognizant Defense Contract Audit Agency (DCAA) audit office (if known)
15	Date proposal was prepared
16	Unique Entity Identifier number
17	TIN number
18	CAGE code
19	Subcontractor information
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)

a. 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. To establish the reasonableness of the offered prices, the Contracting Officer may ask the applicant to provide supporting documentation that assists in this determination. The applicant'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 applicant 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.

b. DCAA-Accepted Accounting System

i. Before a cost-reimbursement type contract can be awarded, the Contracting Officer must confirm that the applicant has a DCAA-accepted accounting system in place for accumulating and billing costs under Government contracts [FAR 53.209-1(f)]. If the applicant has DCAA correspondence, which documents the acceptance of its 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 applicant's accounting system.

ii. If an applicant 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 applicant's internal processes. This will delay contract award.

iii. For more information about cost proposals and accounting standards, view the link titled "Information for Contractors" on the main menu of the DCAA website.

c. Field Pricing Assistance

During the pre-award cost audit process, the Contracting Officer may 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.

d. Sample Cost Proposal – "Piece by Piece"

To help guide applicants through the pre-award cost audit process, a sample cost proposal is detailed below. This sample allows the applicant to see exactly what the Government is looking for so that 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 applicant.

i. Direct Labor: The first cost element included in the cost proposal is Direct Labor. Each proposed employee must be listed by name and labor category.

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

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 Andrews	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 applicant to provide adequate documentation in order to determine that the labor rate for each employee/labor category is fair and reasonable. The documentation must 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 to year. In the example above, the proposed labor escalation is 3% (ex., Andy Smith's direct labor rate increased by 3% from \$55.00/hour in Year 1 to \$56.65/hour in Year 2). Often times, an applicant 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. For example, 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 fiscal year) in the

same location (name location) was published as 3.5%; therefore a 3% increase is fair and reasonable”.

ii. 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 must be detailed in a cost breakdown.

(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 must 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.

The Contracting Officer will require adequate documentation from the applicant 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]:

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

*NOTE: Price competition is not required for items at or below the micro-purchase threshold (\$10,000 - FAR 15.403-1]. If an item’s unit cost is less than or equal to \$10,000, price competition is not necessary. However, if an item’s total cost over the period of performance (unit cost x quantity) is higher than \$10,000, two or more quotes must be obtained by the applicant.

(b) 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 applicant will be required to provide copies of such price lists to the Contracting Officer.

(c) 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.

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

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	\$42,315.00	\$13,825.00

“Raw Materials”: This is a generic label used to group many material items into one cost item within the proposal. The Contracting Officer will require a detailed breakout of all the items that make up this cost. For each separate item over \$10,000 (total for Year 1 + Year 2), the applicant must be able to provide either competitive quotes received, or show that published pricing was used.

“Computer for experiments”: This item is most likely a grouping of several components that make up one system. The Contracting Officer will require a detailed breakout of all the items that make up this cost. For each separate item over \$10,000 (total for Year 1 + Year 2), the applicant must be able to provide either competitive quotes received, or show that published pricing was used.

“Cable”: Since this item is under the micro-purchase threshold of \$10,000, competitive quotes or published pricing are not required. Simply provide documentation to show the Contracting Officer where this price came from.

“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 \$10,000, so competitive quotes or published pricing documentation must be provided.

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 micro-purchase threshold (\$10,000) must be substantiated. There is always an explanation for how the cost of an item was derived; document how you came up with that price.

When it is not possible for an applicant to obtain a vendor price through competitive quotes or published price lists, the 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:

- (a) Evidence that a vendor/supplier charged another applicant 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.
- (b) Previous contract prices. Has the applicant 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.
- (c) 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) ODCs: 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:

ODCs	YEAR 1	YEAR 2
Equipment Rental for Analysis	\$5,500.00	\$5,600.00
Subcontractor – Widget, Inc.	\$25,000.00	\$0.00
Consultant: John Bowers	\$0.00	\$12,000.00
Travel	\$1,250.00	\$1,250.00
Subtotal: ODCs	\$31,750.00	\$18,850.00

“Equipment Rental for Analysis”: The applicant 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 micro-purchase threshold, further documentation to determine cost reasonableness is required. The applicant can furnish another invoice charging a second vendor the same price for the same service.

“Subcontractor – Widget, Inc.”: The applicant 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.

(a) 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.”

(b) 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.

(c) When a subcontractor is selected to provide support under the prime contract due to its specialized experience, the Contracting Officer may request sole source justification from the applicant.

“Consultant – John Bowers”: The applicant 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 applicant 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 applicant 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.

“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 comply with the Joint Travel Regulations. Please see the following website to determine the appropriate lodging and per diem rates: <http://www.defensetravel.dod.mil>. Additionally, the applicant 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 are fair and reasonable.

Below is a sample of the travel portion:

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

iii. *Indirect Costs*: Indirect costs include elements such as fringe benefits, general and administrative (G&A), overhead, and material handling costs. The applicant 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.

Below is the indirect portion of our sample 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

In this example, the applicant includes a fringe benefit rate of 15.00% that it allocated to the direct labor costs. The applicant also proposes a labor overhead rate of 45.00% that is allocated to the direct labor costs plus the fringe benefits.

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 applicants have already completed such reviews and have this documentation readily available. If an applicant is unable to participate in a DCAA review to substantiate indirect rates, the Contracting Officer may request other accounting data from the applicant to make a determination.

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

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

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

2. 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 PI(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:

- i. The basis for the direct labor hours or percentage of effort (e.g., historical hours or estimates);
- ii. 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;
- iii. The portion of time to be devoted to the proposed research, divided between academic and non-academic (summer) terms, when applicable;
- iv. The total annual salary charged to the research project; and
- v. Any details that may affect the salary during the project, such as plans for leave and/or remuneration while on leave.

Note: There is no page limitation for budget proposals or budget justifications.

b. *Fringe Benefits and Indirect Costs (Overhead, G&A, 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, applicants must provide sufficient detail to enable a determination to be made that the costs included in the forecast rate are allocable according to applicable cost provisions. Applicants' 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:

- i. All individual cost elements included in the forecast rate(s);
- ii. Basis used to prorate indirect expenses to cost pools, if any;

- iii. How the rate(s) was calculated;
- iv. Distribution basis of the developed rate(s);
- v. Basis on which the overhead rate is calculated, such as "salaries and wages" or "total costs;" and
- vi. The period of the applicant'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. Applicants 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:

- i. Vendor Quote: Show name of vendor, number of quotes received and justification, if intended award is to other than lowest bidder.
- ii. Historical Cost: Identify vendor, date of purchase, and whether or not cost represents lowest bid. Include reason(s) for not soliciting current quotes.
- iii. Engineering Estimate: Include rationale for quote and reason for not soliciting current quotes.

If applicable, the following additional information shall be disclosed in the applicant's cost proposal:

- iv. Special test equipment to be fabricated by the awardee for specific research purposes and its cost.
 - v. Standard equipment to be acquired and modified to meet specific requirements, including acquisition and modification costs, listed separately.
 - vi. 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.
 - vii. 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. Separate, prior approval by the ARL is required for all foreign travel (i.e., travel outside the continental U.S., its possessions and Canada). Travel may be requested to visit 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, apprenticeships 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: Applicants 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:

- A clear description of the work to be performed;
- If known, the identification of the proposed subawardee and an explanation of why and how the subawardee was selected or will be selected;
- The identification of the type of award to be used (cost reimbursement, fixed price, etc.);
- Whether or not the award will be competitive and, if noncompetitive, rationale to justify the absence of competition; and
- A detailed cost summary.

k. ODCs: 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 must 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 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.

n. FCCM: If cost of money is proposed, a completed FCCM (DD Form 1861) is required.