



Broad Agency Announcement

Arcadia

BIOLOGICAL TECHNOLOGIES OFFICE

HR001121S0039

September 10, 2021

TABLE OF CONTENTS

PART I: OVERVIEW INFORMATION3

PART II: FULL TEXT OF ANNOUNCEMENT4

1. Funding Opportunity Description.....4

1.1. Program Overview 4

1.2. Technical Approach and Program Structure 5

1.3. Program Milestones, Metrics, and Deliverables 11

1.4. General Requirements 17

2. Award Information.....18

2.1. General Award Information 18

2.2. Fundamental Research 19

3. Eligibility Information.....20

3.1. Eligible Applicants 20

3.2. Organizational Conflicts of Interest 21

3.3. Cost Sharing/Matching 21

4. Application and Submission Information22

4.1. Address to Request Application Package 22

4.2. Contact and Form of Application Submission 22

4.3. Funding Restrictions 36

4.4. Other Submission Information 36

5. Application Review Information37

5.1. Evaluation Criteria 37

5.2. Review of Proposals 37

6. Award Administration Information38

6.1. Submission Status Notifications 38

6.2. Administrative and National Policy Requirements 39

6.3. Reporting 40

6.4. Electronic Systems 40

6.5. Embedded Entrepreneurship Initiative (EEI) 40

7. Agency Contacts.....42

8. Other Information42

9. APPENDIX 1 – Volume II checklist43

PART I: OVERVIEW INFORMATION

- **Federal Agency Name** – Defense Advanced Research Projects Agency (DARPA), Biological Technologies Office (BTO)
- **Funding Opportunity Title** – Arcadia
- **Announcement Type** – Initial Announcement
- **Funding Opportunity Number** – HR001121S0039
- **North American Industry Classification System (NAICS)** – 541714
- **Catalog of Federal Domestic Assistance Numbers (CFDA)** – 12.910 Research and Technology Development
- **Dates**
 - Posting Date: **September 10, 2021**
 - Proposal Abstract Due Date and Time: **October 25, 2021, 4:00 PM ET**
 - Full Proposal Due Date and Time: **December 15, 2021, 4:00 PM ET**
 - BAA Closing Date: **December 15, 2021**
 - Proposers' Day: **September 24, 2021**

<https://sam.gov/opp/06fdb7f6f46a4c60a04e3efb15041d1f/view>
- **Concise description of the funding opportunity** – Biofilms are everywhere as a natural part of the environment and routinely degrade military equipment. However, biofilms do not have to be a problem. New insights suggest biofilms could be rendered beneficial by redirecting their composition and structure. The Arcadia program will focus on biofilm-mediated problems, advancing our understanding of how biofilms form and survive which, when combined with advances in bacterial control, will enable us to build the tools and understanding for biofilm management. This will require advances in modeling biofilm and developing testbeds to replicate in-the-field conditions. Multiple testbeds must run in parallel to grow, track, and test biofilms, capturing variables associated with growth and resilience to perturbation, and enabling further model parameterization. Biofilm management strategies will be rigorously tested not only in the laboratory, but also in the field to foster model refinement and to ensure that models predict real-world biofilms.
- **Anticipated individual awards** – Multiple awards are anticipated.
- **Types of instruments that may be awarded** – Procurement contract, grant, cooperative agreement, or other transaction.
- **Agency contact**

The BAA Coordinator for this effort may be reached at:
Arcadia@darpa.mil
DARPA/BTO
ATTN: HR001121S0039
675 North Randolph Street
Arlington, VA 22203-2114

PART II: FULL TEXT OF ANNOUNCEMENT

1. Funding Opportunity Description

This publication constitutes a Broad Agency Announcement (BAA) as contemplated in Federal Acquisition Regulation (FAR) 6.102(d)(2) and 35.016 and 2 C.F.R. § 200.203. Any resultant award negotiations will follow all pertinent law and regulation, and any negotiations and/or awards for procurement contracts will use procedures under FAR 15.4, Contract Pricing, as specified in the BAA.

The Biological Technologies Office (BTO) is soliciting innovative proposals to develop beneficial, functional biofilms capable of reducing drag, decreasing corrosion, or inhibiting black mold growth on military material. Proposed research should investigate innovative approaches that enable revolutionary advances in microbial ecology, systems modeling, or community building. Specifically excluded is research that primarily results in incremental improvements to the existing state of practice.

1.1. PROGRAM OVERVIEW

Bacteria are the most abundant and diverse lifeform on Earth, with the majority spending their lives in biofilms. This lifestyle is universally perceived as problematic since biofilms contribute significantly to equipment degradation, including Department of Defense (DoD) assets. However, *biofilms do not have to be a problem*. New insights suggest biofilms could be rendered beneficial by redirecting their composition and structure. Similar to the Arcadian vision of harmony with nature, **the Arcadia program** will develop “probiotics” for military material using microorganisms that naturally occur on DoD assets to build protective communities. These probiotics will generate robust and beneficial coatings that prevent corrosion, decrease drag, or inhibit the growth of black mold on DoD assets.

Biofouling is a significant and ongoing challenge for the DoD. Biofilms form extensively on stored material, on aircraft and ship hulls, and in hard-to-reach places. Indeed, “microorganisms can eat away at surface materials, and some of the worst areas affected are tight, hard-to-reach areas that maintainers have difficulty disinfecting¹.” In many cases, there is no simple remedy; the fouled surface or area cannot be easily accessed, as is the case for either the inside of fuel tanks or a deployed unmanned underwater vehicle (UUV). Current DoD remedies (scrubbing, dry docking, and fuel-tank draining for repair) have significant, long-term limitations; they must be continually applied at great expense, yielding diminishing returns. Material fouling and degradation could be eliminated by harnessing the naturally occurring microbiota as “material probiotics” and providing protection from deleterious species. The Arcadia program will focus on four application tracks for specific DoD Concept of Operations (CONOPS): drag on UUVs, corrosion in or on UUVs, corrosion in fuel tanks, and black mold growth on DoD assets such as stored vehicles.

¹ AFRL Biological Materials and Processing team leader Wendy Goodson, Sept. 21, 2016.
<https://www.popularmechanics.com/military/research/news/a22960/air-force-plane-eating-bacteria/>

1.2. TECHNICAL APPROACH AND PROGRAM STRUCTURE

Arcadia will combat DoD asset degradation by generating “material probiotics”—biofilms with a beneficial function. Generation of such biofilms will be guided by rigorous modeling of species interactions with a greater focus on niche creation and interactions than on pairwise interactions. Model parameterization can be achieved through multiple sources; however, the performers must generate testbeds that non-destructively track communities so that reproducible, real-time data is acquired. The testbeds may leverage advances in micro- and milli-fluidics and must reproduce the target environment, including relevant disturbances, to the greatest extent possible. Information from the testbeds will feed back into the model, providing further validation and refinement. Testbed data will likely be complemented with high-throughput omics for a systems biology approach to downstream network analysis.

All possible strategies for functional biofilm generation will be examined. Example strategies include, but are not limited to: (1) ‘*assembly*,’ where one starts with a single species and then adds new species in a stepwise fashion; and (2) ‘*displacement*,’ where one starts with a stable community and then displaces a problematic species with a preferred one. Directed community management may also include transient invaders; programmed bacterial release of confounding quorum signals; antibiotics, antimicrobials, or enzymes for biofilm disruption and microorganism degradation; and incompatible extracellular polymeric substance (EPS) scaffold secretion to inhibit reseeding. While the use of genetically modified microorganisms is not a preferred strategy, they may be implemented to serve auxiliary functions to shape the community. **If genetically modified organisms are used, performers must demonstrate a robust containment strategy and plan to seek and receive regulatory approval if needed to enable testing in the field, including the implementation of evolutionarily stable kill switches to limit such communities as well as the programmed die-off of engineered members of the community.**

APPLICATION TRACKS

To focus technology development, performers will choose one of four application tracks: (1) Drag on UUVs/Gliders; (2) Commercial UUV/Glider Corrosion; (3) Fuel-Tank Corrosion; or (4) Black Mold Inhibition. An individual proposal must address both Technical Areas (TA1 and TA2, described below) and must address only one application track. Performers wishing to address multiple applications should submit separate proposals for each.

Description of Tracks:

Biofilm samples from the relevant operational environments described below will be provided by Independent Verification and Validation (IV&V) partners to performers at the beginning of the program, following completion of a material transfer agreement (MTA) with the IV&V team. In Phase II (24-month Option), IV&V testing of the communities in the field will be in conjunction with and coordinated by the IV&V team.

► *Drag on Unmanned Underwater Vehicles (UUVs)/Gliders Track:*

Both private and public entities employ UUVs in a broad range of applications, from environmental sampling to weather monitoring. As the technology advances, increased durability and deployment length are of chief concern. As UUVs/gliders transit from the surface to below

the photic zone for extended periods, biofilms often form from the marine organisms present within the water column. Biofouling on UUVs/gliders increases battery consumption via drag, similar to increased fuel usage of biofouled surface ships.^{2,3} This not only reduces UUV/glider deployment longevity, it also degrades their ability to navigate autonomously. Constant exposure to shear forces, shifts in the physical and chemical conditions between environments, nutrient availability, and the microbial ecology all influence the composition and stability of biofilms formed.^{4,5}

Performers must develop microbial mechanisms for decreasing drag on commercial UUVs/gliders and address the following track metrics:

- By the end of Phase I, laboratory-based testbeds must replicate disturbances experienced by UUVs including: changes in shear-rate stemming from a change in speed from stationary to 4 knots and, secondly, temperature shifts of 10°C. By the end of Phase II, temperature shifts should be 20°C.
- By the end of Phase I, decreased UUV/glider drag must be comparable to UUVs/gliders fouled by light slime, as indicated by the hydrodynamic roughness measure, $k_s < 300 \mu\text{m}$, outlined in Schultz et al., 2015.
- By the end of Phase II, decreased UUV/glider drag must be comparable to hydraulically smooth UUVs/gliders as indicated by the hydrodynamic roughness measure, $k_s < 150 \mu\text{m}$.
- Decreases in drag must not be accompanied by increases in other forms of fouling (e.g., increased corrosion).

► **Commercial Glider/UUV Corrosion Track:**

Similar to surface ships, corrosion is expected to be a challenge for UUV durability and long-term maintenance.⁶ While anti-fouling and anti-corrosive coatings have improved over the past few decades, their efficacy is limited. Various forms of corrosion affect both easily cleanable and hard-to-reach surfaces.

Performers will focus on developing microbial mechanisms for decreasing corrosion in or on commercial UUVs/gliders, addressing the following track metrics:

- By the end of Phase I, laboratory-based testbeds must replicate disturbances experienced by UUVs/gliders including: wet/dry cycling or oxic/anoxic cycling in the presence of salt-water, and temperature shifts by 10°C. By the end of Phase II, temperature shifts should be 20°C.

² Schultz, M. P. 2007. Effects of coating roughness and biofouling on ship resistance and powering. *Biofouling*. 23(5): 331-341. DOI: 10.1080/08927010701461974.

³ Schultz, M. P., Walker, J. M., Steppe, C. N., & K. A. Flack. 2015. Impact of diatomaceous biofilms on the frictional drag of fouling release coatings. *Biofouling*. 31(9-10): 759-773. DOI: 10.1080/08927014.2015.1108407.

⁴ Dang, H., & C. R. Lovell. 2016. Microbial surface colonization and biofilm development in marine environments. *Microbiol and Mol Biol Rev*. 80(1): 91-138. DOI: 10.1128/MMBR.00037-15.

⁵ Orcutt, B. N., Sylvan, J. B., Knab, N. J., & K. J. Edwards. 2011. Microbial ecology of the dark ocean above, at, and below the seafloor. *Microbiol and Mol Biol Rev*. 75(2): 361-422. DOI: 10.1128/MMBR.00039-10.

⁶ Haldeman, C. D., Aragon, D. K., Miles, T., Glenn, S. M., & A. G. Ramos. 2016. Lessening biofouling on long-duration AUV flights: Behavior modifications and lessons learned. *Oceans 2016 MTS/IEEE Monterey*. 1-8. DOI: 10.1109/OCEANS.2016.7761236.

- Communities developed in Phase I must decrease corrosion by 50% as compared to controls.
- Communities further developed in Phase II must decrease corrosion by 90% as compared to controls.
- Decreases in corrosion must not be accompanied by increases in other forms of deleterious fouling, such as increased drag.

► **Fuel-Tank Corrosion Track:**

Atmospheric condensation leads to water accumulation in virtually all fuel tanks; additionally, tanks are prone to leaks that can further increase the amount of water present. Subsequent fuel-water interfaces enable bacterial and fungal growth.^{7,8} These microbes often form resilient biofilms that lead to localized corrosion, contaminated fuel, and debris that clogs downstream filters. The stratified environmental conditions within fuel tanks host unique microbial biofilms that can survive drastic environmental shifts as fuel and water levels change over time.

Performers will focus on developing microbial mechanisms for decreasing corrosion in fuel tanks, addressing the following track metrics:

- By the end of Phase I, laboratory-based testbeds must replicate disturbances experienced by fuel tanks including: wet/dry cycling or oxic/anoxic cycling in the presence of fuel, and temperature shift by 10°C. By the end of Phase II, temperature shift should be 20°C.
- Communities developed in Phase I must decrease corrosion by 50% as compared to controls.
- Communities developed in Phase II must decrease corrosion by 90% as compared to controls.
- Reduced corrosion must not be accompanied by increased fouling (e.g., excess debris shedding leading to filter clogging).

► **Black Mold Inhibition Track:**

DoD assets are often deployed and stored in humid environments that enhance mold growth.⁹ Vehicles are not sealed from the environment; thus, condensation and water damage often occur in the interiors leading to mold growth on material with high cellulose content¹⁰ and on soft, easily damaged areas including seats, belt-buckles, straps, and floorboards. This mold can degrade assets while simultaneously causing potential health concerns for Service members.¹¹ The microbiome of vehicle surfaces is influenced by the environments the vehicles encounter

⁷ Microbial Contamination of Diesel Fuel: Impact, Causes and Prevention. Dow Form no. 253-01246-10/01/03 http://www.hpcdfuel.com/pdf/DOWfuel_training.pdf.

⁸ Stamps, B. W., Bojanowski, C. L., Drake, C. A., Nunn, H. S., Lloyd, P. F., Floyd, J. G., Emmerich, K. A., Neal, A. R., Crookes-Goodson, W. J., & B. S. Stevenson. In situ linkage of fungal and bacterial proliferation to microbiologically influenced corrosion in B20 biodiesel storage tanks. *Front Microbiol.* 11(167): 1-13. DOI: 10.3389/fmicb.2020.00167.

⁹ Li, L., Hongqiang, Z., Yumin, S., Jiongkun, W., Xingxiang G., & L. Kun. 2021. Study on the characteristics of mold in military aviation material warehouse. *E3S Web Conf.* 271(04035). DOI: 10.1051/e3sconf/202127104035.

¹⁰ <https://www.cdc.gov/mold/stachy.htm>.

¹¹ https://www.army.mil/article/159925/mold_exposure_increases_risk_of_respiratory_disease

during deployment and storage;¹² the community must survive with minimal nutrients and water and be resilient to changes in conditions.

Performers will focus on developing microbial mechanisms for inhibiting black mold growth on stored vehicles or other material, addressing the following track metrics:

- By the end of Phase I, laboratory-based testbeds must replicate disturbances experienced by military equipment including: humidity cycling on vinyl, floorboards, or other relevant material, and temperature shifts by 10°C. By the end of Phase II, temperature shifts should be 20°C.
- Communities developed in Phase I must inhibit black mold growth for 2 weeks as measured by >1 cm zone of inhibition.
- Communities developed in Phase II must inhibit black mold growth for 6 months as measured by >1 cm zone of inhibition.
- Decreased black mold growth must not be accompanied by corrosion or other material degradation.

Table 1: CONOPS-Associated Disturbances and Targeted Function

	Drag	Corrosion	Black Mold	All Systems
Disturbance	Change in shear rates/speed from stationary to 4 knots	Marine: wet/dry or oxic/anoxic cycling in the presence of salt H ₂ O Fuel tanks: wet/dry or oxic/anoxic cycling in the presence of fuel	Humidity cycling on equipment	Temperature cycling
Target Behavior				
<i>24 months</i>	Decrease drag for a UUV/Submarine/Glider from heavy to light slime ($k_s < 300 \mu\text{m}$)	50% decrease in corrosion as compared to control	Inhibit growth for 2 weeks as measured by >1 cm zone of inhibition	Resilient to temperature swing of 10°C
<i>48 months</i>	Decrease drag for a UUV/ Submarine/ Glider from light slime to hydraulically smooth ($k_s < 150 \mu\text{m}$)	90% decrease in corrosion as compared to control	Inhibit growth for 6 months as measured by >1 cm zone of inhibition	Resilient to temperature swing of 20°C

¹² Leung, M. H. Y., & P. K. H. Lee. 2016. The roles of the outdoors and occupants in contributing to a potential pan-microbiome of the built environment: a review. *Microbiome*. 4(21): 1-15. DOI: 10.1186/s40168-016-0165-2

TECHNICAL AREAS

Each track will address the same Technical Areas (TAs): Modeling & Analysis of Community Interactions (TA1) and Engineering a Functional and Resilient Biofilm (TA2). The technology will be developed over two phases. During Phase I (24 months), performer teams will directly engage with Independent Verification and Validation (IV&V) partners, coordinated by DARPA, who will provide DoD-relevant biofilm samples. Performer teams will then develop high-throughput testbeds to characterize these samples and thereby parameterize their models. Data gleaned at the bench will directly inform network community analyses and models to further develop the target function that is resilient to disturbance(s) for two weeks in the testbed.

During Phase II (24-month Option), performer teams will continue direct engagement with IV&V partners for community testing in an operational environment. Communities must be stable and exhibit track-associated function after two months in the field.

Technical Area 1 (TA1): Model and Analyze Community Interactions

Performers will develop high-throughput testbeds that track the physical properties of biofilms along with their community structure. The testbeds will recreate track-specific disturbances, such as changes in temperature or shear force, similar to those experienced in the field. Performers will generate predictive models using biological, chemical, and/or mechanical spatiotemporal data to identify lynch-pin members or ideal community structures that provide the target function. Phase I will focus on model generation and prediction within the laboratory. Efforts will continue into the Phase II Option with model refinement to match responses seen in the field. Ultimately, performers will generate a tool for predicting the biofilm response to extended and unexpected disturbances.

- Testbeds must track biofilms in real-time and in a non-destructive manner.
- Testbeds must recreate CONOPS-specific disturbances (Table 1) with a biofilm *Design-Build-Test* cycle <1 month.
- Testbeds must be scalable for the level of parameterization necessary to achieve a predictive model. The testbed must test multiple parameters in parallel.
- Models must predict temporal responses to disturbances both at the bench and in the field.
- Models must identify key community members or specific member behavior that generates the target function (corrosion prevention, etc.).

Technical Area 2 (TA2): Engineer a Functional and Resilient Biofilm

Using insights from TA1, performers will engineer biofilms that are resilient to disturbance(s) and have the desired functionality. TA2 will develop the techniques to inoculate, perturb, or displace species at the correct time to shape the community trajectory, guiding it to the target biofilm state. Methods could include iterative assembly, displacement, or other strategies that utilize microorganisms that either act independently or in cooperative ways. For example, performers may leverage mechanisms such as microbial succession where species arise and subside during biofilm formation, similar to how fallow ground becomes forest through successive growth and death. Final community composition may be achieved through various trajectory manipulations, e.g., founder effects, similar to how different old-growth forests are

achieved through varying species arrival order. Phase I will focus on building communities at the bench based on DoD-relevant biofilm samples. It will culminate with stable biofilms that demonstrate both the targeted properties and resilience to relevant physical perturbations, such as temperature, and biological perturbations, such as invasion by species from the operational environment. The Phase II Option will focus on iteratively testing the communities in the field while refining the laboratory-based testbeds so that they better represent field conditions to “bring the wild back to the lab.”

- Communities must be stable and reproducible as measured by β -diversity or other similarity measures proposed by performer.
- At a minimum, communities must either withstand or recover from CONOPS-specific disturbance cycle(s) as defined below (**Table 1**). Proposers are encouraged to add additional disturbances that are relevant to the specific CONOPS and are potentially associated with community stability in the application of interest.
- Communities must maintain function and stability when challenged with invaders from the natural environment in a lab setting.
- Communities must maintain function and stability when deployed in the field.
- Community modification methods should be compatible with CONOPS-specific scaling.

Independent Verification and Validation (IV&V)

Throughout the program, performers will work with an IV&V team established by DARPA. This team will consist of subject matter experts from the Government, Federally Funded Research and Development Centers (FFRDCs), academia and/or other relevant domains. The Arcadia IV&V team will test and validate the technology developed, specifically confirming that track-specific functionality is generated and communities are resilient to track-specific disturbances while maintaining targeted functionality. At the beginning of Phase I, IV&V teams will provide application-specific biofilm samples and supporting omics level data to help initiate studies. Testing and validation at the end of Phase I will involve sample sharing and testbed verification while the Phase II Option will incorporate in-the-field testing and validation.

To avoid potential conflicts of interest, performers for HR001121S0039 will not be allowed to compete for the IV&V contract. HR001121S0039 is not soliciting proposals for IV&V.

Government-furnished Property/Equipment/Information:

To support research and development in both TAs, DARPA IV&V partners will supply performer(s) with biofilm samples and supporting omics data. These values will be provided at the start of the program and should be used to inform the design of TA1 and TA2 methodologies. IV&V teams will prepare initial MTA agreements for the transfer. Selected teams should facilitate rapid negotiation and signing of approvals to prevent program delays.

Schedule

The Arcadia program will span 4 years and consist of a 24-month Phase I and a 24-month Phase II Option. While performer completion of the final task will occur at 48-months, final IV&V testing will be completed at 54-months. Progress towards the stated goals will be assessed throughout the program. The Phase II Option funding will be dependent on funding availability and performance towards Phase I-specific milestones.

During Phase I, performers will develop track-specific testbeds that replicate the operational environment and associated disturbances while generating sample numbers necessary for accurate model analysis (TA1). Information gleaned through testbed-generated data and model analysis will directly inform community structure at the relevant functional level (e.g., metabolism, composition, spatiotemporal relationships, etc.) (TA2). By the end of Phase I, testbed design must be scalable to run ≥ 50 testbeds in parallel, and communities must be resilient to relevant disturbances while maintaining function for ≥ 2 -weeks in the lab; communities must also maintain resilience and function after 1 week of exposure to native organisms from the field.

During the Phase II Option, performers must test their lab-developed communities in the field while refining their models to predict real-world, in-the-field systems and disturbed community re-assembly. By the end of Phase II, models must have $>90\%$ accuracy and precision for 1 month of in-the-field community predictions, and communities must be stable and maintain function after 6 months in the field.

1.3. PROGRAM MILESTONES, METRICS, AND DELIVERABLES

Progress toward the program goal will be determined through the use of regular milestones, metrics, and deliverables. The Government specifies the following minimally-required milestones, metrics, and deliverables to bound the effort while still affording the maximum flexibility, creativity, and innovation in proposing solutions to the stated problems. **Proposers are expected to define additional quantitative and qualitative success criteria as needed.** Proposers must clearly and uniquely itemize tasks needed to accomplish planned milestones and deliverables.

Proposals must be written to address milestones in both TAs: Model and Analyze Community Interactions (TA1) and Engineer a Functional and Resilient Biofilm (TA2)—with metrics that align to one application track. **Proposals that do not address both Technical Areas (TAs) or that attempt to address more than one application track will be considered non-conforming and may be removed from consideration (rejected without review).** The minimum milestones and metrics for each technical area and phase are outlined below. Proposers must explain quantitative success criteria for each milestone and provide information on how these will be achieved in their Statement of Work (SOW). Proposers are also encouraged to identify metrics beyond the minimum defined below.

COMMON METRICS

The following metrics are common to all of the tracks. **All proposals must address both the common and the track-specific metrics (specified below).** Note that “disturbance” and “target behavior” are defined in Table 1.

Phase I (Months 1 through 24)

Phase I, *24 months*, will comprise testbed and model development to directly inform the targeted community and function. At the end of Phase I, performers must demonstrate that the engineered community(ies) maintain CONOPS-specific function and are resilient to disturbances for ≥ 2 -weeks within the testbed. Testbeds must replicate the CONOPS-specific disturbance and be able

to track communities non-destructively. Additionally, performers must have at least 50 different testbeds functioning in parallel. To accomplish this, performers will demonstrate design-build-test cycles that are relevant to the application and that require less than 1 month per cycle, enabling effective model building to predict temporal responses to disturbances. Model and testbed development (TA1) will feed directly into engineering a functional and resilient biofilm (TA2). By the end of Phase I, the community must be reproducible, maintain function, and either withstand or recover within 1 day ≥ 1 disturbance cycle(s) (Table 1) and ≥ 1 temperature cycle(s). Additionally, the engineered community must produce and maintain CONOPS-specific function after 1 week of exposure to organisms from the field.

Milestones and Metrics: Technical Area 1

- Demonstrate testbeds can recreate the disturbance (Table 1). (8 months)
- Demonstrate testbeds can non-destructively track at least one key aspect of the biofilms, as defined by the proposer, in real-time while generating the disturbance. (8 months)
- Demonstrate testbeds enable design-build-test cycles of <1 month. (8 months)
- Demonstrate testbed scalability with ≥ 10 testbeds that can measure the target behavior (Table 1) while running in parallel. (12 months)
- Demonstrate the model predicts biofilm assembly in static conditions (i.e., without the disturbance), with >90% accuracy and precision. (12 months)
- Demonstrate the model predicts the engineered community's temporal response to the disturbance with >80% accuracy for an entire disturbance cycle. Disturbance cycles are specified below for each track. (18 months)
- Demonstrate the model predicts the engineered community's temporal response to changes in temperature with >80% accuracy for one full temperature cycle. One cycle is defined as follows: temperature shift of 10 °C for 2-hours, and a return to starting temperature and community recovery all within 24 hours. (18 months)
- Demonstrate the model can identify key community members or specific member behavior(s) that generate the target behavior. (18 months)
- Demonstrate ≥ 50 testbeds can run in parallel and track multiple changes in the target behavior. (18 months)
- Demonstrate the model predicts engineered community temporal response(s) to changes in temperature and the disturbance with >80% accuracy for ≥ 2 weeks. The engineered community must have experienced ≥ 1 cycle/change in the disturbance and ≥ 1 temperature shift of 10 °C within those two weeks. (21 months)
- Identify and characterize the mechanisms by which organisms from the field disrupt the target behavior of the engineered community after 1 week of exposure to organisms from the field. (24 months)

Milestones and Metrics: Technical Area 2

- Demonstrate the engineered community is stable after 7 days under static conditions, as measured by either β -diversity and variance or another relevant metric. (9 months)
- Demonstrate the end composition of the engineered community is reproducible after 7 days, as measured by β -diversity, level of variance, or another relevant metric. (9 months)
- Demonstrate the engineered community can either withstand or recover from ≥ 1 disturbance cycle within 24 hours. (18 months)

- Demonstrate the engineered community can withstand or recover from changes in temperature for one full temperature cycle. One cycle is defined as follows: temperature shift of 10 °C (positive or negative) for 2 hours, with a return to starting temperature and community recovery all within 24 hours. (18 months)
- Demonstrate the engineered community or community members are resilient to ≥ 1 disturbance and ≥ 1 10 °C temperature shift within ≥ 2 weeks in the testbed while maintaining target behavior. Engineered community resilience to be determined via β -diversity, variance, or another relevant metric. Measurements to be taken at $t=0$ and $t=2$ -wks at a minimum for resilience determination. (21 months)

Independent Verification & Validation:

- Implement MTAs and have appropriate documentation in place to receive biofilm samples from relevant operational environment. (1 month)
- Generate and share biofilm sequencing data between performer and Government partner. (6 months)

Phase II Option (Months 25 through 48)

Phase II, *24 months (Option)*, will focus on model and testbed refinement and move from work primarily performed in the lab to work primarily performed in the field. Engineered community functionality and resiliency will be put to the test for longer periods of time, culminating in a final, 6-month, proof-of-concept test.

Milestones and Metrics: Technical Area 1

- Demonstrate testbeds and models combined can predict biofilm composition in the field with >75% accuracy and precision. (30 months)
- Predict biofilm composition and function in the field with >85% accuracy and precision. (36 months)
- Demonstrate the model predicts the operational environment in-the-field systems and disturbed engineered community composition and function with >90% accuracy and precision for 2 months. (48 months)

Milestones and Metrics: Technical Area 2

- Develop and demonstrate in the lab the engineered community can withstand ≥ 3 consecutive disturbance cycles or recover within 1 day after consecutive disturbances have occurred. (30 months)
- Demonstrate in the lab the engineered community is stable after 7 days in the field, as measured by either β -diversity and variance or another relevant metric. (30 months)
- Performers will deliver engineered communities to IV&V teams who will validate function and resilience. (30 months)
- Demonstrate in the lab the engineered community is stable and could maintain the target behavior after 2 months in the field. (36 months)
- Performers will deliver engineered communities to IV&V teams who will validate 2-month function and resilience. (36 months)
- Demonstrate the engineered community is stable and maintains the target behavior after 6 months in the field. It must not increase other application-related fouling (e.g., corrosion

- if the target behavior is drag reduction) as compared to controls. (48 months)
- Performers will deliver engineered communities to IV&V teams who will validate 6-month function and resilience. (48 months)

Independent Verification & Validation:

- IV&V teams will validate the engineered community can withstand ≥ 3 consecutive disturbance cycles or recover within 1 day after consecutive disturbances have occurred and deliver results to the performers. (30.25 months)
- IV&V teams will validate the engineered community is stable in the field after 7 days. (30.25 months)
- IV&V teams will validate the engineered community is stable and maintains the target behavior after 2 months in the field. (38 months)
- IV&V teams will validate the engineered community is stable and maintains the target behavior after 6 months in the field. (54 months)

APPLICATION TRACK-SPECIFIC METRICS

Additional technical objectives for each TA are listed specifically for each application track. Descriptions of Phases I-II for [decreased drag](#), [decreased corrosion](#) (marine or fuel-tank), and [black mold inhibition](#) appear in Section 1.2.

DRAG: TECHNICAL AREAS, SPECIFIC MILESTONES AND METRICS

Phase I (Months 1 through 24)

Goal: Performers must develop an engineered community that reduces drag on a UUV/glider similar to light slime levels after 2 weeks. Testbeds should recreate the shear rate experienced by a UUV/glider moving at 4-knots. The engineered community must have experienced ≥ 1 cycle/change in shear rate and ≥ 1 temperature shift of 10 °C within those 2 weeks.

Milestones and Metrics: Technical Area 1

- One disturbance cycle is defined as follows: Starting condition is a shear-rate experienced by UUVs/gliders at 4-knots, decreased speed to static for 2 hours, and a subsequent return to previous shear-rate conditions for community recovery on day 2. Alternate disturbance cycles may be proposed but must be justified based on the defined CONOPS. (18 months)

Milestones and Metrics: Technical Area 2

- Demonstrate that after 2 weeks, drag should be no greater than that experienced by UUVs/gliders with light slime (equivalent sand roughness height, k_s , less than 300 μm).^{13,14} The engineered community must not increase other application related fouling (e.g., corrosion) as compared to controls. (21 months)
- Performers will deliver engineered communities to IV&V teams, who will validate

¹³ Schultz, M. P. 2007. Effects of coating roughness and biofouling on ship resistance and powering. *Biofouling*. 23(5): 331-341. DOI: 10.1080/08927010701461974

¹⁴ Schultz, M. P., Walker, J. M., Steppe, C. N., & K. A. Flack. 2015. Impact of diatomaceous biofilms on the frictional drag of fouling release coatings. *Biofouling*. 31(9-10): 759-773. DOI: 10.1080/08927014.2015.1108407

function and resilience. (21 months)

Independent Verification & Validation:

- IV&V teams will validate the engineered community or community members decrease drag at shear rates associated with UUVs/gliders moving at a speed of 4-knots. Decreased drag should be similar to drag experienced by UUVs/gliders with light slime ($k_s < 300 \mu\text{m}$). (22 months)

Phase II Option (Months 25 through 48)

Goal: Performers must develop an engineered community that can decrease drag versus control on a UUV/glider after 6 months in the field. Specifically, drag must be similar to what a freshly painted, hydraulically smooth ($k_s < 150 \mu\text{m}$) UUV/glider experiences when moving at a speed of 4-knots. The engineered community must be resilient to ≥ 3 cycle/changes in shear rate and ≥ 3 temperature shifts of 20°C while maintaining the reduced amount of drag.

Independent Verification & Validation:

- IV&V teams will validate the engineered community is stable and maintain drag at shear rates associated with hydraulically smooth UUVs/gliders moving at a speed of 4-knots after 2 months in the field. (38 months)
- IV&V teams will validate the engineered community is stable and maintain drag at shear rates associated with hydraulically smooth UUVs/gliders moving at a speed of 4-knots after 6 months in the field. (54 months)

UUV/GLIDER OR FUEL-TANK CORROSION: TECHNICAL AREAS, SPECIFIC MILESTONES AND METRICS

Phase I (Months 1 through 24)

Goal: Performers must develop an engineered community that can reduce corrosion either on or in a UUV/glider in the presence of saltwater or in a fuel tank in the presence of fuel. Corrosion must be reduced by 50% after 2 weeks as compared to controls, and testbeds should recreate the corrosion experienced by a UUV/glider or fuel tank. Additionally, the engineered community must have experienced ≥ 1 wet/dry or oxic/anoxic cycle and ≥ 1 temperature shift of 10°C within those 2 weeks.

Milestones and Metrics: Technical Area 1

- One disturbance cycle is defined as follows: wet/dry or oxic/anoxic conditions for day 1, and a return to initial conditions opposite of the cycle on day 2; the engineered community(ies) may recover on day 2 as well. Alternate disturbance cycles may be proposed but must be justified based on the defined CONOPS. (18 months)
- The testbed should reproduce corrosion levels a UUV/glider or fuel tank experiences in the presence of saltwater or fuel. (18 months)

Milestones and Metrics: Technical Area 2

- Demonstrate the engineered community or community members reduce corrosion associated with UUVs/gliders or fuel tanks for ≥ 2 weeks in the testbed. Corrosion should be decreased by 50% in the presence of either saltwater or fuel, as compared to controls. The engineered community must not increase other application-related fouling (e.g., drag, filter clogging) as compared to controls. (21 months)
- Performers will deliver engineered communities to IV&V teams, who will validate function and resilience. (21 months)

Independent Verification & Validation:

- IV&V teams will validate the ability of the engineered community or community members to reduce corrosion by 50% in the presence of either saltwater or fuel. (22 months)

Phase II Option (Months 25 through 48)

Goal: Performers must develop an engineered community that can reduce corrosion either on or in a UUV/gliders in the presence of saltwater or in a fuel tank in the presence of fuel. Corrosion must be reduced by 90% after 6 months in the field, as compared to controls. The engineered community must be resilient to ≥ 3 cycle/changes in oxic/anoxic cycling or wet/dry cycling and ≥ 3 temperature shifts of 20 °C. Alternate disturbance cycles may be proposed but must be justified based on the defined CONOPS.

Independent Verification & Validation:

- IV&V teams will validate the engineered community is stable and reduces corrosion in fuel tanks by 90% after 2 months in the field. (38 months)
- IV&V teams will validate the engineered community is stable and reduces corrosion in fuel tanks by 90% after 6 months in the field. (54 months)

BLACK MOLD INHIBITION: TECHNICAL AREAS, SPECIFIC MILESTONES AND METRICS

Phase I (Months 1 through 24)

At the end of Phase I, performers must demonstrate that the engineered community(ies) inhibit black mold growth on relevant material (e.g., vinyl, seatbelts, floorboards) and are resilient for at least 2-weeks in the testbed. Additionally, performers must show that at least 50 different testbeds function in parallel.

Goal: Performers must develop an engineered community that is able to inhibit black mold growth on relevant military material. Black mold must be inhibited from growing with > 1 cm zone of inhibition. The engineered community must have experienced ≥ 1 wet/dry cycling and ≥ 1 temperature shift of 10 °C within those 2 weeks.

Milestones and Metrics: Technical Area 1

- One disturbance cycle is defined as follows: humid/dry conditions for day 1, and a return to initial conditions opposite of the cycle on day 2; the community(ies) may recover on

day 2 as well. Alternate disturbance cycles may be proposed but must be justified based on the defined CONOPS. (18 months)

Milestones and Metrics: Technical Area 2

- Demonstrate the engineered community or community members inhibit black mold growth associated with DoD relevant material for ≥ 2 weeks in the testbed. Black mold inhibition should have a zone of clearing > 1 cm. The engineered community must not increase other application-related fouling (e.g., corrosion, filter clogging) as compared to controls. (21 months)
- Demonstrate the engineered community or community members inhibit mold growth after 2 weeks in the presence of wet/dry cycling. (21 months)
- Performers will deliver engineered communities to IV&V teams, who will validate function and resilience. (21 months)

Independent Verification & Validation:

- IV&V teams will validate that the engineered community or community members inhibit black mold growth after 2 weeks with >1 cm zone of inhibition. (22 months)

Phase II Option (Months 25 through 48)

Phase II, *24 months*, will focus on model and testbed refinement and move from work primarily performed in the lab to work primarily performed in the field. Community functionality and resiliency will be put to the test for longer periods of time, culminating in a final 6-month proof-of-concept test.

Goal: Performers must develop an engineered community that inhibits black mold growth with a zone of inhibition >1 cm after 6 months in the field. The engineered community must be resilient to ≥ 3 cycle/changes in shear rate and ≥ 3 temperature shifts of 20 °C.

Independent Verification & Validation:

- IV&V teams will validate the engineered community is stable and inhibits mold growth on material by >1 cm zone of inhibition after 2 months in the field. (38 months)
- IV&V teams will validate the engineered community is stable and inhibits mold growth on material by >1 cm zone of inhibition after 6 months in the field. (54 months)

1.4. GENERAL REQUIREMENTS

Proposing Teams

Proposer teams must address both Technical Areas (TA1 and TA2), which should run in parallel, and select one Application Track. Specific content, communications, networking, and team formation are the sole responsibility of the proposer teams. Proposer teams must submit a single, integrated proposal led by a single Principal Investigator or prime contractor.

Permits and Compliance

It is the proposing team's responsibility to obtain all necessary federal, state, and local government permits and approvals, and abide by all applicable laws where necessary for the

proposed work to be conducted.

Other Requirements

Performers are expected to attend semi-annual program reviews to provide updates to the DARPA program management team and other Arcadia performers on progress towards their milestones and scientific goals on the Arcadia program. Performers will also summarize outstanding challenges and limitations that must still be overcome to achieve the overarching goals of the program.

2. Award Information

2.1. GENERAL AWARD INFORMATION

Multiple awards are possible. The amount of resources made available under this BAA will depend on the quality of the proposals received and the availability of funds.

The Government reserves the right to select for negotiation all, some, one, or none of the proposals received in response to this solicitation and to make awards without discussions with proposers. The Government also reserves the right to conduct discussions if it is later determined to be necessary. If warranted, portions of resulting awards may be segregated into pre-priced options. Additionally, DARPA reserves the right to accept proposals in their entirety or to select only portions of proposals for award. In the event that DARPA desires to award only portions of a proposal, negotiations may be opened with that proposer. The Government reserves the right to fund proposals in phases with options for continued work, as applicable.

The Government reserves the right to request any additional, necessary documentation once it makes the award instrument determination. Such additional information may include but is not limited to Representations and Certifications (see Section VI.B.2., “Representations and Certifications”). The Government reserves the right to remove proposers from award consideration should the parties fail to reach agreement on award terms, conditions, and/or cost/price within a reasonable time, and the proposer fails to timely provide requested additional information. Proposals identified for negotiation may result in a procurement contract, grant, cooperative agreement, or other transaction, depending upon the nature of the work proposed, the required degree of interaction between parties, whether or not the research is classified as Fundamental Research, and other factors.

Proposers looking for innovative, commercial-like contractual arrangements are encouraged to consider requesting Other Transactions. To understand the flexibility and options associated with Other Transactions, consult <http://www.darpa.mil/work-with-us/contract-management#OtherTransactions>.

In accordance with 10 U.S.C. § 2371b(f), the Government may award a follow-on production contract or Other Transaction (OT) for any OT awarded under this solicitation if: (1) that participant in the OT, or a recognized successor in interest to the OT, successfully completed the entire prototype project provided for in the OT, as modified; and (2) the OT provides for the award of a follow-on production contract or OT to the participant, or a recognized successor in interest to the OT.

In all cases, the Government contracting officer shall have sole discretion to select award instrument type, regardless of instrument type proposed, and to negotiate all instrument terms and conditions with selectees. DARPA will apply publication or other restrictions, as necessary, if it determines that the research resulting from the proposed effort will present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense. Any award resulting from such a determination will include a requirement for DARPA permission before publishing any information or results on the program. For more information on publication restrictions, see the section below on Fundamental Research.

2.2. FUNDAMENTAL RESEARCH

It is DoD policy that the publication of products of fundamental research will remain unrestricted to the maximum extent possible. National Security Decision Directive (NSDD) 189 defines fundamental research as follows:

‘Fundamental research’ means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons.

As of the date of publication of this solicitation, the Government expects that program goals as described herein may be met by proposers intending to perform fundamental research and does not anticipate applying publication restrictions of any kind to individual awards for fundamental research that may result from this solicitation. Notwithstanding this statement of expectation, the Government is not prohibited from considering and selecting research proposals that, while perhaps not qualifying as fundamental research under the foregoing definition, still meet the solicitation criteria for submissions. If proposals are selected for award that offer other than a fundamental research solution, the Government will either work with the proposer to modify the proposed statement of work to bring the research back into line with fundamental research or else the proposer will agree to restrictions in order to receive an award.

Proposers should indicate in their proposal whether they believe the scope of the research included in their proposal is fundamental or not. While proposers should clearly explain the intended results of their research, the Government shall have sole discretion to determine whether the proposed research shall be considered fundamental and to select the award instrument type. Appropriate language will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate. This language can be found at <http://www.darpa.mil/work-with-us/additional-baa>. For certain research projects, it may be possible that although the research to be performed by a potential awardee is non-fundamental research, its proposed subawardee’s effort may be fundamental research. It is also possible that the research performed by a potential awardee is fundamental research while its proposed subawardee’s effort may be non-fundamental research. In all cases, it is the potential awardee’s responsibility to explain in its proposal which proposed

efforts are fundamental research and why the proposed efforts should be considered fundamental research.

3. Eligibility Information

3.1. ELIGIBLE APPLICANTS

All responsible sources capable of satisfying the Government's needs may submit a proposal that shall be considered by DARPA.

3.1.1. Federally Funded Research and Development Centers (FFRDCs) and Government Entities

FFRDCs

FFRDCs are subject to applicable direct competition limitations and cannot propose to this solicitation in any capacity unless they meet the following conditions. (1) FFRDCs must clearly demonstrate that the proposed work is not otherwise available from the private sector. (2) FFRDCs must provide a letter, on official letterhead from their sponsoring organization, that (a) cites the specific authority establishing their eligibility to propose to Government solicitations and compete with industry, and (b) certifies the FFRDC's compliance with the associated FFRDC sponsor agreement's terms and conditions. These conditions are a requirement for FFRDCs proposing to be awardees or subawardees.

Government Entities

Government Entities (e.g., Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations. Government Entities must clearly demonstrate that the work is not otherwise available from the private sector and provide written documentation citing the specific statutory authority and contractual authority, if relevant, establishing their ability to propose to Government solicitations and compete with industry. This information is required for Government Entities proposing to be awardees or subawardees.

Authority and Eligibility

At the present time, DARPA does not consider 15 U.S.C. § 3710a to be sufficient legal authority to show eligibility. While 10 U.S.C. § 2539b may be the appropriate statutory starting point for some entities, specific supporting regulatory guidance, together with evidence of agency approval, will still be required to fully establish eligibility. DARPA will consider FFRDC and Government Entity eligibility submissions on a case-by-case basis; however, the burden to prove eligibility for all team members rests solely with the proposer.

3.1.2. Non-U.S. Organizations

Non-U.S. organizations and/or individuals may participate to the extent that such participants comply with any necessary nondisclosure agreements, security regulations, export control laws, and other governing statutes applicable under the circumstances.

3.2. ORGANIZATIONAL CONFLICTS OF INTEREST

FAR 9.5 Requirements

In accordance with FAR 9.5, proposers are required to identify and disclose all facts relevant to potential OCIs involving the proposer's organization and *any* proposed team member (subawardee, consultant). Under this Section, the proposer is responsible for providing this disclosure with each proposal submitted to the solicitation. The disclosure must include the proposer's, and as applicable, proposed team member's OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposer has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposer's judgment and to prevent the proposer from having unfair competitive advantage. The OCI mitigation plan will specifically discuss the disclosed OCI in the context of each of the OCI limitations outlined in FAR 9.505-1 through FAR 9.505-4.

Agency Supplemental OCI Policy

In addition, DARPA has a supplemental OCI policy that prohibits contractors/performers from concurrently providing Scientific Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS) or similar support services and being a technical performer. Therefore, as part of the FAR 9.5 disclosure requirement above, a proposer must affirm whether the proposer or *any* proposed team member (subawardee, consultant) is providing SETA, A&AS, or similar support to any DARPA office(s) under: (a) a current award or subaward; or (b) a past award or subaward that ended within one calendar year prior to the proposal's submission date. If SETA, A&AS, or similar support is being or was provided to any DARPA office(s), the proposal must include:

- The name of the DARPA office receiving the support;
- The prime contract number;
- Identification of proposed team member (subawardee, consultant) providing the support; and
- An OCI mitigation plan in accordance with FAR 9.5.

Government Procedures

In accordance with FAR 9.503, 9.504 and 9.506, the Government will evaluate OCI mitigation plans to avoid, neutralize or mitigate potential OCI issues before award and to determine whether it is in the Government's interest to grant a waiver. The Government will only evaluate OCI mitigation plans for proposals that are determined selectable under the solicitation evaluation criteria and funding availability.

The Government may require proposers to provide additional information to assist the Government in evaluating the proposer's OCI mitigation plan.

If the Government determines that a proposer failed to fully disclose an OCI; or failed to provide the affirmation of DARPA support as described above; or failed to reasonably provide additional information requested by the Government to assist in evaluating the proposer's OCI mitigation plan, the Government may reject the proposal and withdraw it from consideration for award.

3.3. COST SHARING/MATCHING

Cost sharing is not required; however, it will be carefully considered where there is an applicable statutory condition relating to the selected funding instrument. Cost sharing is encouraged where there is a reasonable probability of a potential commercial application related to the proposed research and development effort.

4. Application and Submission Information

4.1. ADDRESS TO REQUEST APPLICATION PACKAGE

This announcement, any attachments, and any references to external websites herein constitute the total solicitation. If proposers cannot access the referenced material posted in the announcement found at <http://www.darpa.mil>, contact the administrative contact listed herein.

4.2. CONTACT AND FORM OF APPLICATION SUBMISSION

All submissions, including abstracts and proposals, must be written in English with type no smaller than 12-point font. Smaller font may be used for figures, tables, and charts. The page limitation includes all figures, tables, and charts. All pages shall be formatted for printing on 8-1/2 by 11-inch paper. Margins must be 1-inch on all sides. Copies of all documents submitted must be clearly labeled with the DARPA BAA number, proposer organization, and proposal title/proposal short title.

4.2.1. Proposal Abstract Format

Proposers are strongly encouraged to submit an abstract in advance of a proposal to minimize effort and reduce the potential expense of preparing an out-of-scope proposal. DARPA will respond to abstracts providing feedback and indicating whether, after preliminary review, there is interest within BTO for the proposed work. DARPA will attempt to reply within **20** calendar days of receipt. Proposals may be submitted irrespective of comments or feedback received in response to the abstract. Proposals are reviewed without regard to feedback given as a result of abstract review. The time and date for submission of proposal abstracts are specified in Part I above.

The abstract is a concise version of the proposal comprising a maximum of **eight (8)** pages, including all figures, tables, and charts.

The page limit does NOT include:

- Official transmittal letter (optional);
- Cover sheet;
- Executive summary slide;
- Resumes; and
- Bibliography (optional).

Abstracts must include the following components:

A. Cover Sheet (does not count towards page limit): Include the administrative and technical points of contact (name, address, phone, fax, e-mail, lead organization). Also include the BAA number, title of the proposed project, primary subcontractors, estimated cost, duration of the project, and the label “ABSTRACT.”

B. Goals and Impact: Clearly describe what is being proposed and what difference it will make (qualitatively and quantitatively), including brief answers to the following questions:

1. What is the proposed work attempting to accomplish or do?
2. How is it done today? And what are the limitations?
3. What is innovative in your approach, and how does it compare to the current state-of-the-art (SOA)?
4. What are the key technical challenges in your approach, and how do you plan to overcome these?
5. Who will care, and what will the impact be if you are successful?
6. How much will it cost, and how long will it take?

C. Executive Summary Slides: The slide template is provided as **Attachment 1** to the BAA posted at <https://SAM.gov/>. Use of this template is required.

D. Technical Plan: Outline and address all technical areas and challenges inherent in the approach and possible solutions for overcoming potential problems. This section should provide specific objectives, metrics, and milestones at intermediate stages of the project to demonstrate a plan for accomplishment of the program goals. Propose additional appropriate qualitative and quantitative metrics specific to the approach, as needed. Outline of intermediary milestones should occur at no greater than 6-month increments.

E. Management and Capabilities: Provide a brief summary of expertise of the team, including subcontractors and key personnel.

A principal investigator for the project must be identified, and a description of the team's organization, including a breakdown by Technical Area (TA). All teams are strongly encouraged to identify a Project Manager/Integrator to serve as the primary point of contact to communicate with the DARPA Program Manager, IV&V partner, and Contracting Officer's Representative, coordinate the effort across co-performer, vendor, and subcontractor teams, organize regular performer meetings or discussions, facilitate data sharing, and ensure timely completion of milestones and deliverables.

Include a description of the team's organization, including roles and responsibilities. Team member descriptions should address the Technical Plan, describe the time and percent effort divisions for members participating across multiple TAs, and delineate individuals to avoid duplication of efforts.

Describe the organizational experience in this area, existing intellectual property required to complete the project, and any specialized facilities to be used as part of the project. List Government-furnished materials or data assumed to be available. Describe any specialized facilities to be used as part of the project, the extent of access to these facilities, and any biological containment, biosafety, and certification requirements.

F. Cost and Schedule: Provide a cost estimate for resources over the proposed timeline of the project, broken down by phase and major cost items (e.g., labor, materials, etc.). Include cost estimates for each potential subcontractor (may be a rough order of magnitude).

G. Resumes: Include resumes of key personnel ONLY, one of which must be from/for the Principal Investigator (does not count towards page limit).

H. Bibliography: If desired, include a brief bibliography with links to relevant papers and/or reports (does not count towards page limit, should not exceed two pages).

4.2.2. Proposal Format

All full proposals must be in the format given below. Proposals shall consist of two volumes: 1) **Volume I, Technical and Management Proposal**, and 2) **Volume II, Cost Proposal**. Volume I, Technical and Management Proposal, may include an attached bibliography of relevant technical papers or research notes (published and unpublished) which document the technical ideas and approach upon which the proposal is based. Copies of not more than three (3) relevant papers may be included with the submission. The bibliography and attached papers are not included in the page counts given below. The submission of other supporting materials along with the proposals is strongly discouraged and will not be considered for review. **The maximum page count for Volume I is 35 pages.** The official transmittal letter is not included in the page count. Volume I should include the following components:

NOTE: Non-conforming submissions that do not address both Technical Areas and a single application track and/or follow the instructions herein may be rejected without further review.

a. Volume I, Technical and Management Proposal

Section I. Administrative

A. Cover Sheet (LABELED “PROPOSAL: VOLUME I”):

1. BAA number (HR001121S0039);
2. Lead organization submitting proposal (prime contractor);
3. Type of organization, selected from among the following categories: “LARGE BUSINESS,” “SMALL DISADVANTAGED BUSINESS,” “OTHER SMALL BUSINESS,” “HBCU,” “MI,” “OTHER EDUCATIONAL,” OR “OTHER NONPROFIT”;
4. Proposer’s reference number (if any);
5. Other team members (if applicable) and type of business for each;
6. Proposal title;

7. Technical point of contact (Program Manager or Principle Investigator) to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax, e-mail;
8. Administrative point of contact (Contracting Officer or Award Officer) to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax, e-mail;
9. Award instrument requested: cost-plus-fixed-fee (CPFF), cost-award—no fee, cost sharing contract – no fee, or other type of procurement contract (*specify*), GRANT, cooperative agreement, or other transaction;
10. Place(s) of performance, including all subcontractors and consultants;
11. Period of performance;
12. Total funds requested from DARPA, total funds requested per phase and the amount of any cost share (if any);
13. Proposal validity period; AND
14. Date proposal was submitted.

Information on award instruments is available at <http://www.darpa.mil/work-with-us/contract-management>.

B. Official Transmittal Letter.

C. Executive Summary Slides: The slide template is provided as **Attachment 1** to the BAA posted at <https://SAM.gov>. Use of this template is required.

Section II. Detailed Proposal Information

A. Executive Summary: Provide a synopsis of the proposed project, including answers to the following questions:

- What is the proposed work attempting to accomplish or do?
- How is it done today, and what are the limitations?
- What is innovative in your approach?
- What are the key technical challenges in your approach, and how do you plan to overcome these?
- Who or what will be affected, and what will be the impact if the work is successful?
- How much will it cost, and how long will it take?

B. Goals and Impact: Clearly describe what the team is trying to achieve and the difference it will make (qualitatively and quantitatively) if successful. Describe the innovative aspects of the project in the context of existing capabilities and approaches, clearly delineating the uniqueness and benefits of this project in the context of the state of the art, alternative approaches, and other projects from the past and present. Describe

how the proposed project is revolutionary and how it significantly rises above the current state-of-the-art. Describe the deliverables associated with the proposed project and any plans to commercialize the technology, transition it to a customer, or further the work.

- C. Technical Plan:** Outline and address technical challenges inherent in the approach and possible solutions for overcoming potential problems. This section should provide appropriate measurable milestones (quantitative if possible) at intermediate stages of the program to demonstrate progress, plan for achieving the milestones, and must include a simple process flow diagram of their final system concept. The technical plan should demonstrate a deep understanding of the technical challenges and present a credible (even if risky) plan to achieve the program goal. Discuss mitigation of technical risk.
- D. Management Plan:** Provide a summary of expertise of the team, including any subcontractors, and key personnel who will be doing the work. A Principal Investigator (PI) for the project must be identified, along with a description of the team's organization, including the breakdown by Technical Area. All teams are strongly encouraged to identify a Project Manager/Integrator to serve as the primary point of contact to communicate with the DARPA Program Manager, IV & V partner, and Contracting Officer's Representative, coordinate the effort across co-performer, vendor, and subcontractor teams, organize regular performer meetings or discussions, facilitate data sharing, and ensure timely completion of milestones and deliverables.

Provide a clear description of the team's organization, including an organization chart that includes, as applicable: the programmatic relationship of team members; the unique capabilities of team members; the task responsibilities of team members, the teaming strategy among the team members; and key personnel with the amount of effort to be expended by each person during each year. Provide a detailed plan for coordination, including explicit guidelines for interaction among collaborators/subcontractors of the proposed effort. Include risk management approaches. Describe any formal teaming agreements that are required to execute this program.

- E. Capabilities:** Describe organizational experience in relevant subject area(s), existing intellectual property, specialized facilities, and any Government-furnished materials or information. Describe any specialized facilities to be used as part of the project, the extent of access to these facilities, and any biological containment, biosafety, and certification requirements. Discuss any work in closely related research areas and previous accomplishments.

F. Statement of Work (SOW) NOT INCLUDED IN PAGE COUNT: The SOW should provide a detailed task breakdown, citing specific tasks for each Technical Area, and their connection to the milestones and program metrics. Each phase of the program should be separately defined. The SOW must not include proprietary information. It is encouraged, though not required, to use the SOW template provided as **Attachment 2**. SOW is not included in the Volume 1 page count.

For each task/subtask, provide:

- A detailed description of the approach to be taken to accomplish each defined task/subtask.
- Identification of the primary organization responsible for task execution (prime contractor, subcontractor(s), consultant(s), by name).
- A measurable milestone, i.e., a deliverable, demonstration, or other event/activity that marks task completion. Include completion dates for all milestones. Include quantitative metrics.
- A definition of all deliverables (e.g., data, reports, software) to be provided to the Government in support of the proposed tasks/subtasks.

It is recommended that the SOW be developed so that each Technical Area and Phase of the program is separately defined.

G. Schedule and Milestones: Provide a detailed schedule showing tasks (task name, duration, work breakdown structure element as applicable, performing organization), milestones, and the interrelationships among tasks. The task structure must be consistent with that in the SOW. Measurable milestones should be clearly articulated and defined in time relative to the start of the project.

H. Technology Transfer Plan: Provide information regarding the types of partners (e.g., government, private industry) that will be pursued and submit a timeline with incremental milestones toward successful engagement. The plan should include a description of how DARPA will be included in the development of potential technology transfer relationships. If the Technology Transfer Plan includes the formation of a start-up company, a business development strategy must also be provided.

a. Volume II, Cost Management Proposal

Cover Sheet (LABELED “PROPOSAL: VOLUME II”):

1. BAA Number (HR001121S0039);
2. Lead organization submitting proposal;

3. Type of organization, selected among the following categories: “LARGE BUSINESS”, “SMALL DISADVANTAGED BUSINESS”, “OTHER SMALL BUSINESS”, “HBCU”, “MI”, “OTHER EDUCATIONAL”, OR “OTHER NONPROFIT”;
4. Proposer’s reference number (if any);
5. Other team members (if applicable) and type of business for each;
6. Proposal title;
7. Technical point of contact (Program Manager or Principal Investigator) to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available);
8. Administrative point of contact (Contracting Officer or Award Officer) to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), and electronic mail (if available);
9. Award instrument requested: cost-plus-fixed-fee (CPFF), cost-contract—no fee, cost sharing contract – no fee, or other type of procurement contract (*specify*), GRANT, cooperative agreement, or other transaction;
10. Place(s) of performance, including all subcontractors and consultants;
11. Period of performance;
12. Total funds requested from DARPA, total funds requested per phase (as defined in Table 1), and the amount of any cost share (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. Data Universal Numbering System (DUNS) number (<http://www.dnb.com/get-a-duns-number.html>);
17. Taxpayer ID number (<https://www.irs.gov/Individuals/International-Taxpayers/Taxpayer-Identification-Numbers-TIN>);
18. Commercial and Government Entity (CAGE) code (<https://cage.dla.mil/Home/UsageAgree>);
19. Proposal validity period

NOTE: Non-conforming submissions that do not address both Technical Areas and a single application track and/or follow the instructions herein may be rejected without further review.

The Government requires that proposers use the provided MS Excel™ DARPA Standard Cost Proposal Spreadsheet in the development of their cost proposals. A customized cost proposal spreadsheet may be an attachment to this solicitation. If not, the spreadsheet can be found on the DARPA website at <http://www.darpa.mil/work-with-us/contract-management> (under “Resources” on the right-hand side of the webpage). All tabs and tables in the cost proposal spreadsheet should be developed in an editable format with calculation formulas intact to allow

traceability of the cost proposal. This cost proposal spreadsheet should be used by the prime organization and all subcontractors. In addition to using the cost proposal spreadsheet, the cost proposal still must include all other items required in this announcement that are not covered by the editable spreadsheet. Subcontractor cost proposal spreadsheets may be submitted directly to the Government by the proposed subcontractor via e-mail to the address in Part I of this solicitation. **Using the provided cost proposal spreadsheet will assist the Government in a rapid analysis of your proposed costs and, if your proposal is selected for a potential award, speed up the negotiation and award execution process.**

- (1) Total program, per phase (Phase I (Base); and Phase II (Option)); and per task cost broken down by major cost items to include:
 - i. **Direct labor** – provide an itemized breakout of all personnel, listed by name or TBD, with labor rate (or salary), labor hours (or percent effort), and labor category. All senior personnel must be identified by name.
 - ii. **Materials and Supplies** – itemized list which includes description of material, quantity, unit price, and total price. If a material factor is used based on historical purchases, provide data to justify the rate.
 - iii. **Equipment** – itemized list which includes description of equipment, unit price, quantity, and total price. Any equipment item with a unit price over \$5,000 must include a vendor quote.
 - iv. **Animal Use Costs** – itemized list of all materials, animal purchases, and per diem costs, associated with proposed animal use; include documentation supporting daily rates.
 - v. **Travel** – provide an itemized list of travel costs to include purpose of trips, departure and arrival destinations, projected airfare, rental car and per GSA approved diem, number of travelers, number of days); provide screenshots from travel website for proposed airfare and rental car, as applicable; provide screenshot or web link for conference registration fee and note if the fee includes hotel cost. Conference attendance must be justified, explain how it is in the best interest of the project. **Plan for two (2) DARPA program review meetings per year.**
 - vi. **Other Direct Costs (e.g., computer support, clean room fees)** – Should be itemized with costs or estimated costs. Backup documentation and/or a supporting cost breakdown is required to support proposed costs with a unit price over \$5,000. An explanation of any estimating factors, including their derivation and application, must be provided. Please include a brief description of the proposers' procurement method to be used.
 - vii. **Other Direct Costs** – Consultants: provide executed Consultant Agreement that describes work scope, rate and hours.
 - viii. **Indirect costs** including, as applicable, fringe benefits, overhead, General and Administrative (G&A) expense, and cost of money (see university vs. company-specific requirements below).
 - ix. **Indirect costs specific to a University performer: (1) Fringe Benefit Rate** (provide current Department of Health and Human Services (DHHS) or Office of Naval Research (ONR) negotiated rate package; if calculated by other than a rate, provide University documentation identifying fringe

costs by position or HR documentation if unique to each person); (2) **F&A Indirect Overhead Rate** (provide current DHHS or ONR negotiated rate package); (3) **Tuition Remission** (provide current University documentation justifying per-student amount); and (4) **Health Insurance/Fee** (provide current University documentation justifying per student amount, if priced separately from fringe benefits with calculations included in the EXCEL cost file).

Indirect costs specific to a Company performer: (1) **Fee/Profit** (provide rationale for proposed fee/profit percentage using criteria found in DFARS 215.404-70); and (2) **Fringe Benefit/Labor OH/Material OH/G&A Rates** (provide current Forwarding Pricing Rate Proposal (FPRP) or DCMA/DCAA Forward Pricing Rate Recommendation or Agreement (FPRR or FPRA). If these documents are not available, provide company historical data, preferably two years, minimum of one, to include both pool and expense costs used to generate the rates).

- (2) A summary of total program costs by phase I and II and task.
- (3) An itemization of Subcontracts. All subcontractor cost proposal documentation must be prepared at the same level of detail as that required of the prime. Subcontractor proposals should include Interdivisional Work Transfer Agreements (IWTA) or evidence of similar arrangements (an IWTA is an agreement between multiple divisions of the same organization). The prime proposer is responsible for compiling and providing all subcontractor proposals for the Procuring Contracting Officer (PCO). The proposal must show how subcontractor costs are applied to each phase and task. If consultants are to be used, proposer must provide consultant agreement or other document that verifies the proposed loaded daily/hourly rate.
- (4) An itemization of any information technology (IT) purchase (including a letter stating why the proposer cannot provide the requested resources from its own funding), as defined in FAR Part 2.101.
- (5) A summary of projected funding requirements by month for all phases of the project.
- (6) A summary of tasks that have animal or human use funding.
- (7) The source, nature, and amount of any industry cost-sharing. Where the effort consists of multiple portions that could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates for each.
- (8) Identification of pricing assumptions of which may require incorporation into the resulting award instrument (e.g., use of Government Furnished Property/Facilities/Information, access to Government Subject Matter Expert/s, etc.).
- (9) Any Forward Pricing Rate Agreement, DHHS rate agreement, other such approved rate information, or such documentation that may assist in expediting negotiations (if available).
- (10) Proposers with a Government acceptable accounting system who are proposing a cost-type contract must submit the DCAA document approving the cost accounting system.

Per FAR 15.403-4, certified cost or pricing data shall be required if the proposer is seeking a procurement contract award per the referenced threshold, unless the proposer requests and is granted an exception from the requirement to submit cost or pricing data. Certified cost or pricing data” are not required if the proposer proposes an award instrument other than a procurement contract (e.g., a grant, cooperative agreement, or other transaction).

Subawardee Proposals

The awardee is responsible for compiling and providing all subawardee proposals for the Procuring Contracting Officer (PCO)/Grants Officer (GO)/Agreements Officer (AO), as applicable. Subawardee proposals should include Interdivisional Work Transfer Agreements (ITWA) or similar arrangements. Where the effort consists of multiple portions which could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates for each.

All proprietary subawardee proposal documentation, prepared at the same level of detail as that required of the awardee’s proposal and which cannot be uploaded with the proposed awardee’s proposal, shall be provided to the Government either by the awardee or by the subawardee organization when the proposal is submitted. Subawardee proposals submitted to the Government by the proposed subawardee should be submitted via e-mail to the address in Section I.

Other Transaction (OT) Requests

All proposers requesting an OT must include a detailed list of milestones for each phase of the program (I, II, and III). Each milestone must include the following:

- milestone description,
- completion criteria,
- due date, and
- payment/funding schedule (to include, if cost share is proposed, awardee and Government share amounts).

It is noted that, at a minimum, milestones should relate directly to accomplishment of program technical metrics as defined in the BAA and/or the proposer’s proposal. Agreement type, expenditure or fixed-price based, will be subject to negotiation by the Agreements Officer. Do not include proprietary data.

4.2.3. Additional Proposal Information

Proprietary Markings

Proposers are responsible for clearly identifying proprietary information. Submissions containing proprietary information must have the cover page and each page containing such information clearly marked with a label such as “Proprietary” or “Company Proprietary.” NOTE: “Confidential” is a classification marking used to control the dissemination of U.S. Government National Security Information as dictated in Executive Order 13526 and should not be used to identify proprietary business information.

Unclassified Submissions

DARPA anticipates that submissions received under this BAA will be unclassified. However, should a proposer wish to submit classified information, an *unclassified* e-mail must be sent to the BAA mailbox requesting submission instructions from the Technical Office Program Security Officer (PSO). If a determination is made that the award instrument may result in access to classified information, a Security Classification Guide (SCG) and/or DD Form 254 will be issued by DARPA and attached as part of the award.

Disclosure of Information and Compliance with Safeguarding Covered Defense Information Controls

The following provisions and clause apply to all solicitations and contracts; however, the definition of “controlled technical information” clearly exempts work considered fundamental research and therefore, even though included in the contract, will not apply if the work is fundamental research.

DFARS 252.204-7000, “Disclosure of Information”

DFARS 252.204-7008, “Compliance with Safeguarding Covered Defense Information Controls”

DFARS 252.204-7012, “Safeguarding Covered Defense Information and Cyber Incident Reporting”

The full text of the above solicitation provision and contract clauses can be found at

<http://www.darpa.mil/work-with-us/additional-baa#NPRPAC>.

Compliance with the above requirements includes the mandate for proposers to implement the security requirements specified by National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, “Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations” (see

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-171r2.pdf>) and DoDI 8582.01 that are in effect at the time the solicitation is issued.

For awards where the work is considered fundamental research, the contractor will not have to implement the aforementioned requirements and safeguards. However, should the nature of the work change during performance of the award, work not considered fundamental research will be subject to these requirements.

Human Subjects Research (HSR)/Animal Use

Proposers that anticipate involving human subjects or animals in the proposed research must comply with the approval procedures detailed at <http://www.darpa.mil/work-with-us/additional-baa>, to include providing the information specified therein as required for proposal submission.

Approved Cost Accounting System Documentation

Proposers that do not have a Cost Accounting Standards (CAS) compliant accounting system considered adequate for determining accurate costs that are negotiating a cost-type procurement contract must complete an SF 1408. For more information on CAS compliance, see <http://www.dcaa.mil/cas.html>. To facilitate this process, proposers should complete the SF 1408 found at <http://www.gsa.gov/portal/forms/download/115778> and submit the completed form with the proposal.

Small Business Subcontracting Plan

Pursuant to Section 8(d) of the Small Business Act (15 U.S.C. § 637(d)) and FAR 19.702(a)(1), each proposer who submits a contract proposal and includes subcontractors might be required to submit a subcontracting plan with their proposal. The plan format is outlined in FAR 19.704.

Section 508 of the Rehabilitation Act (29 U.S.C. § 749d)/FAR 39.2

All electronic and information technology acquired or created through this BAA must satisfy the accessibility requirements of Section 508 of the Rehabilitation Act (29 U.S.C. § 749d)/FAR 39.2.

Grant Abstract

Per Section 8123 of the Department of Defense Appropriations Act, 2015 (Pub. L. 113-235), all grant awards must be posted on a public website in a searchable format. To comply with this requirement, proposers requesting grant awards must submit a maximum one (1) page abstract that may be publicly posted and explains the program or project to the public. The proposer should sign the bottom of the abstract confirming the information in the abstract is approved for public release. Proposers are advised to provide both a signed PDF copy, as well as an editable (e.g., Microsoft word) copy. Abstracts contained in grant proposals that are not selected for award will not be publicly posted.

Intellectual Property

All proposers must provide a good faith representation that the proposer either owns or possesses the appropriate licensing rights to all intellectual property that will be utilized under the proposed effort.

For Procurement Contracts

Proposers responding to this BAA requesting procurement contracts will need to complete the certifications at DFARS 252.227-7017. See <http://www.darpa.mil/work-with-us/additional-baa> for further information. If no restrictions are intended, the proposer should state “none.” The table below captures the requested information:

Technical Data Computer Software To be Furnished With Restrictions	Summary of Intended Use in the Conduct of the Research	Basis for Assertion	Asserted Rights Category	Name of Person Asserting Restrictions
(LIST)	(NARRATIVE)	(LIST)	(LIST)	(LIST)

For All Non-Procurement Contracts

Proposers responding to this BAA requesting a Cooperative Agreement, Technology Investment Agreement, or Other Transaction for Prototypes shall follow the applicable rules and regulations governing these various award instruments, but, in all cases, should appropriately identify any potential restrictions on the Government's use of any Intellectual Property contemplated under the award instrument in question. This includes both Noncommercial Items and Commercial Items. Proposers are encouraged to use a format similar to that described in the section above. If no restrictions are intended, then the proposer should state "NONE."

System for Award Management (SAM) and Universal Identifier Requirements

All proposers must be registered in SAM unless exempt per FAR 4.1102. FAR 52.204-7, "System for Award Management" and FAR 52.204-13, "System for Award Management Maintenance" are incorporated into this solicitation. See <http://www.darpa.mil/work-with-us/additional-baa> for further information.

International entities can register in SAM by following the instructions in this link: https://www.fsd.gov/sys_attachment.do?sys_id=c08b64ab1b4434109ac5ddb6bc4bcbb8.

4.2.4. Submission Information

DARPA will acknowledge receipt of all submissions and assign an identifying control number that should be used in all further correspondence regarding the submission. DARPA intends to use electronic mail correspondence regarding HR001121S0039. Submissions may not be sent by fax or e-mail; any so sent will be disregarded.

Submissions will not be returned. An electronic copy of each submission received will be retained at DARPA and all other non-required copies destroyed. A certification of destruction may be requested, provided the formal request is received by DARPA within 5 days after notification that a proposal was not selected.

For abstract and proposal submission dates, see Part I., Overview Information. Submissions received after these dates and times may not be reviewed.

Abstracts and Full Proposals sent in response to HR001121S0039 may be submitted via DARPA's BAA Website (<https://baa.darpa.mil>). Visit the website to complete the two-step registration process. Submitters will need to register for an Extranet account (via the form at the URL listed above) and wait for two separate e-mails containing a username and temporary password. After accessing the Extranet, submitters may then create an account for the DARPA BAA website (via the "Register your Organization" link along the left side of the homepage), view submission instructions, and upload/finalize the abstract. Proposers using the DARPA BAA Website may encounter heavy traffic on the submission deadline date; it is highly advised that the submission process be started as early as possible.

All unclassified concepts submitted electronically through DARPA's BAA Website must be uploaded as zip files (.zip or .zipx extension). The final zip file should be no greater than 50 MB in size. Only one zip file will be accepted per submission. Classified submissions and proposals

requesting or cooperative agreements should NOT be submitted through DARPA's BAA Website (<https://baa.darpa.mil>), though proposers will likely still need to visit <https://baa.darpa.mil> to register their organization (or verify an existing registration) to ensure the BAA office can verify and finalize their submission.

Technical support for BAA Website may be reached at BAAT_Support@darpa.mil, and is typically available during regular business hours (9:00 AM- 5:00 PM EST Monday – Friday).

Proposers using the DARPA BAA Website may encounter heavy traffic on the submission deadline date; it is highly advised that the submission process be started as early as possible.

For Grants or Cooperative Agreements only:

Proposers requesting grants or cooperative agreements must submit proposals through one of the following methods: (1) electronic upload per the instructions at <https://www.grants.gov/applicants/apply-for-grants.html> (DARPA-preferred); or (2) hard-copy mailed directly to DARPA. If proposers intend to use Grants.gov as their means of submission, then they must submit their entire proposal through Grants.gov; applications cannot be submitted in part to Grants.gov and in part as a hard-copy. Proposers using Grants.gov do not submit hard-copy proposals in addition to the Grants.gov electronic submission.

Submissions: In addition to the volumes and corresponding attachments requested elsewhere in this solicitation, proposers must also submit the three forms listed below.

Form 1: SF 424 Research and Related (R&R) Application for Federal Assistance, available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_SF424_2_0-V2.0.pdf. This form must be completed and submitted.

To evaluate compliance with Title IX of the Education Amendments of 1972 (20 U.S.C. § 1681 et.seq.), the Department of Defense (DoD) 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 science, technology, engineering or mathematics disciplines. In addition, the National Defense Authorization Act (NDAA) for FY 2019, Section 1286, directs the Secretary of Defense to protect intellectual property, controlled information, key personnel, and information about critical technologies relevant to national security and limit undue influence, including foreign talent programs by countries that desire to exploit United States' technology within the DoD research, science and technology, and innovation enterprise. This requirement is necessary for all research and research-related educational activities. The DoD is using the two forms below to collect the necessary information to satisfy these requirements. Detailed instructions for each form are available on Grants.gov.

Form 2: Research and Related Senior/Key Person Profile (Expanded), available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_KeyPersonExpanded_2_0-V2.0.pdf. This form must be completed and submitted.

The Research and Related Senior/Key Person Profile (Expanded) form will be used to collect the following information for all senior/key personnel, including Project Director/Principal Investigator and Co-Project Director/Co-Principal Investigator, whether or not the individuals' efforts under the project are funded by the DoD:

- Degree Type and Degree Year.

- Current and Pending Support, including:
 - A list of all current projects the individual is working on, in addition to any future support the individual has applied to receive, regardless of the source.
 - Title and objectives of the other research projects.
 - The percentage per year to be devoted to the other projects.
 - The total amount of support the individual is receiving in connection to each of the other research projects or will receive if other proposals are awarded.
 - Name and address of the agencies and/or other parties supporting the other research projects
 - Period of performance for the other research projects.

Additional senior/key persons can be added by selecting the “Next Person” button at the bottom of the form. Note that, although applications without this information completed may pass Grants.gov edit checks, if DARPA receives an application without the required information, DARPA may determine that the application is incomplete and may cause your submission to be rejected and eliminated from further review and consideration under the solicitation. DARPA reserves the right to request further details from the applicant before making a final determination on funding the effort.

Form 3: Research and Related Personal Data, available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_PersonalData_1_2-V1.2.pdf. Each applicant must complete the name field of this form, however, provision of the demographic information is voluntary. Regardless of whether the demographic fields are completed or not, this form must be submitted with at least the applicant’s name completed.

Grants.gov Submissions: Grants.gov requires proposers to complete a one-time registration process before a proposal can be electronically submitted. First-time registration can take between three business days and four weeks. For more information about registering for Grants.gov, see <http://www.darpa.mil/work-with-us/additional-baa>.

Proposal abstracts will not be accepted if submitted via Grants.gov.

Hard copy Submissions: Proposers electing to submit cooperative agreement proposals as hard copies must complete the SF 424 R&R form (Application for Federal Assistance), available on the Grants.gov website (https://apply07.grants.gov/apply/forms/sample/SF424_2_1-V2.1.pdf).

Failure to comply with the submission procedures may result in the submission not being evaluated. DARPA will acknowledge receipt of complete submissions via e-mail and assign control numbers that should be used in all further correspondence regarding proposals.

4.3. FUNDING RESTRICTIONS

Not applicable.

4.4. OTHER SUBMISSION INFORMATION

DARPA will post a consolidated Frequently Asked Questions (FAQ) document. To access the posting go to <http://www.darpa.mil/work-with-us/opportunities>. A link to the FAQ will appear under the HR001121S0039 summary. Submit your question(s) via e-mail to Arcadia@darpa.mil.

5. Application Review Information

5.1. EVALUATION CRITERIA

Proposals will be evaluated using the following criteria, listed in descending order of importance: 5.1.1 Overall Scientific and Technical Merit; 5.1.2 Potential Contribution and Relevance to the DARPA Mission; and 5.1.3 Cost Realism.

5.1.1. Overall Scientific and Technical Merit

The proposed technical approach is innovative, feasible, achievable, and complete. The proposed technical team has the expertise and experience to accomplish the proposed tasks. Task descriptions and associated technical elements provided are complete and in a logical sequence with all proposed deliverables clearly defined such that a final outcome that achieves the goal can be expected as a result of award. The proposal identifies major technical risks, and planned mitigation efforts are clearly defined and feasible. The timeline for achieving major milestones is aggressive but rationally supported with a clear description of the requirements and risks. The proposer's prior experience in similar efforts must clearly demonstrate an ability to deliver products that meet the proposed technical performance within the proposed budget and schedule. The proposed team has the expertise to manage the cost and schedule.

5.1.2. Potential Contribution and Relevance to the DARPA Mission

The potential contributions of the proposed effort are relevant to the national technology base. Specifically, DARPA's mission is to make pivotal early technology investments that create or prevent strategic surprise for U.S. National Security.

5.1.3. Cost Realism

The proposed costs are realistic for the technical and management approach and accurately reflect the technical goals and objectives of the solicitation. The proposed costs are consistent with the proposer's Statement of Work and reflect a sufficient understanding of the costs and level of effort needed to successfully accomplish the proposed technical approach. The costs for the prime proposer and proposed subawardees are substantiated by the details provided in the proposal (e.g., the type and number of labor hours proposed per task, the types and quantities of materials, equipment and fabrication costs, travel and any other applicable costs and the basis for the estimates).

It is expected that the effort will leverage all available relevant prior research in order to obtain the maximum benefit from the available funding. For efforts with a likelihood of commercial application, appropriate direct cost sharing may be a positive factor in the evaluation. DARPA recognizes that undue emphasis on cost may motivate proposers to offer low-risk ideas with minimum uncertainty and to staff the effort with junior personnel in order to be in a more competitive posture. DARPA discourages such cost strategies.

5.2. REVIEW OF PROPOSALS

Review Process

It is the policy of DARPA to ensure impartial, equitable, comprehensive proposal evaluations based on the evaluation criteria listed in Section 5.1. and to select the source (or sources) whose offer meets the Government's technical, policy, and programmatic goals.

DARPA will conduct a scientific/technical review of each conforming proposal. Conforming proposals comply with all requirements detailed in this solicitation; proposals that fail to do so may be deemed non-conforming and may be removed from consideration. Proposals will not be evaluated against each other since they are not submitted in accordance with a common work statement. DARPA's intent is to review proposals as soon as possible after they arrive; however, proposals may be reviewed periodically for administrative reasons.

Award(s) will be made to proposers whose proposals are determined to be the most advantageous to the Government, consistent with instructions and evaluation criteria specified in the BAA herein, and availability of funding.

Handling of Source Selection Information

DARPA policy is to treat all submissions as source selection information (see FAR 2.101 and 3.104) and to disclose their contents only for the purpose of evaluation. Restrictive notices notwithstanding, during the evaluation process, submissions may be handled by support contractors for administrative purposes and/or to assist with technical evaluation. All DARPA support contractors performing this role are expressly prohibited from performing DARPA-sponsored technical research and are bound by appropriate nondisclosure agreements.

Subject to the restrictions set forth in FAR 37.203(d), input on technical aspects of the proposals may be solicited by DARPA from non-Government consultants/experts who are strictly bound by the appropriate nondisclosure requirements.

Federal Awardee Performance and Integrity Information (FAPIIS)

Per 41 U.S.C. § 2313, as implemented by FAR 9.103 and 2 CFR § 200.205, prior to making an award above the simplified acquisition threshold, DARPA is required to review and consider any information available through the designated integrity and performance system (currently FAPIIS). Awardees have the opportunity to comment on any information about themselves entered in the database, and DARPA will consider any comments, along with other information in FAPIIS or other systems, prior to making an award.

6. Award Administration Information

6.1. SUBMISSION STATUS NOTIFICATIONS

Proposal Abstracts and Full Proposals submitted in response to HR001121S0039 will be evaluated following the submission deadlines listed in Part 1. DARPA will respond as described below. These official notifications will be sent via e-mail to the Technical Point of Contact (POC) and/or Administrative POC identified on the submission coversheet.

6.1.1. Proposal Abstracts

DARPA will respond to abstracts with a statement as to whether DARPA is interested in the idea. If DARPA does not recommend the proposer submit a full proposal, DARPA will provide feedback to the proposer regarding the rationale for this decision. Regardless of DARPA's response to an abstract, proposers may submit a full proposal. DARPA will review all conforming full proposals using the published evaluation criteria and without regard to any comments resulting from the review of an abstract.

6.1.2. Full Proposals

As soon as the evaluation of a proposal is complete, the proposer will be notified that (1) the proposal has been selected for funding pending award negotiations, in whole or in part, or (2) the proposal has not been selected.

6.2. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

6.2.1. Meeting and Travel Requirements

There will be a program kickoff meeting in the Arlington, VA vicinity, and all key participants are required to attend. Performers should also anticipate regular program-wide PI meetings and periodic site visits at the Program Manager's discretion to the Arlington, VA vicinity. Proposers shall include within the content of their proposal details and costs of any travel or meetings they deem to be necessary throughout the course of the effort, to include periodic status reviews by the government.

6.2.2. Solicitation Provisions and Award Clauses, Terms and Conditions

Solicitation clauses in the FAR and DFARS relevant to procurement contracts and FAR and DFARS clauses that may be included in any resultant procurement contracts are incorporated herein and can be found at <http://www.darpa.mil/work-with-us/additional-baa>.

6.2.3. Controlled Unclassified Information (CUI) and Controlled Technical Information (CTI) on Non-DoD Information Systems

Further information on Controlled Unclassified Information on Non-DoD Information Systems is incorporated herein can be found at <http://www.darpa.mil/work-with-us/additional-baa>.

6.2.4. Representations and Certifications

In accordance with FAR 4.1102 and 4.1201, proposers requesting a procurement contract must complete electronic annual representations and certifications at <https://www.sam.gov/>.

In addition, all proposers are required to submit for all award instrument types supplementary DARPA-specific representations and certifications at the time of proposal submission. See <http://www.darpa.mil/work-with-us/rep-certs> for further information on required representation and certification depending on your requested award instrument.

6.2.5. Terms and Conditions

For terms and conditions specific to grants and/or cooperative agreements, see the DoD General Research Terms and Conditions (latest version) at <http://www.onr.navy.mil/Contracts-Grants/submit-proposal/grants-proposal/grants-terms-conditions> and the supplemental DARPA-

specific terms and conditions at <http://www.darpa.mil/work-with-us/contract-management#GrantsCooperativeAgreements>.

6.3. REPORTING

The number and types of reports will be specified in the award document, but will include as a minimum monthly financial status reports, 6-week technical status reports, and quarterly technical status reports. The reports shall be prepared and submitted in accordance with the procedures contained in the award document and mutually agreed on 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, notwithstanding the fact that the research may be continued under a follow-on vehicle.

6.4. ELECTRONIC SYSTEMS

6.4.1. Wide Area Work Flow (WAWF)

Performers will be required to submit invoices for payment directly to <https://wawf.eb.mil>, unless an exception applies. Performers must register in WAWF prior to any award under this BAA.

6.4.2. I-EDISON

The award document for each proposal selected for funding will contain a mandatory requirement for patent reports and notifications to be submitted electronically through i-Edison (<http://public.era.nih.gov/iedison>).

6.5. EMBEDDED ENTREPRENEURSHIP INITIATIVE (EEI)

Awardees pursuant to this solicitation may be eligible to participate in the DARPA Embedded Entrepreneurship Initiative (EEI) during the award's period of performance. EEI is a limited scope program offered by DARPA, at DARPA's discretion, to a small subset of awardees. The goal of DARPA's EEI is to increase the likelihood that DARPA-funded technologies take root in the U.S. and provide new capabilities for national defense. EEI supports DARPA's mission "to make pivotal investments in breakthrough technologies and capabilities for national security" by accelerating the transition of innovations out of the lab and into new capabilities for the Department of Defense (DoD). EEI investment supports development of a robust and deliberate Go-to-Market strategy for selling technology product to the government and commercial markets and positions DARPA awardees to attract U.S. investment. The following is for informational and planning purposes only and does not constitute solicitation of proposals to the EEI.

There are three elements to DARPA's EEI: (1) A Senior Commercialization Advisor (SCA) from DARPA who works with the Program Manager (PM) to examine the business case for the awardee's technology and uses commercial methodologies to identify steps toward achieving a successful transition of technology to the government and commercial markets; (2) Connections to potential industry and investor partners via EEI's Investor Working Groups; and (3) Additional funding on an awardee's contract for the awardee to hire an embedded entrepreneur to achieve specific milestones in a Go-to-Market strategy for transitioning the technology to products that serve both defense and commercial markets. This embedded entrepreneur's

qualifications should include business experience within the target industries of interest, experience in commercializing early-stage technology, and the ability to communicate and interact with technical and non-technical stakeholders. Funding for EEI is typically no more than \$250,000 per awardee over the duration of the award. An awardee may apportion EEI funding to hire more than one embedded entrepreneur, if achieving the milestones requires different expertise that can be obtained without exceeding the awardee's total EEI funding. The EEI effort is intended to be conducted concurrent with the research program without extending the period of performance.

EEI Application Process:

After receiving an award under the solicitation, awardees interested in being considered for EEI should notify their DARPA Program Manager (PM) during the period of performance. Timing of such notification should ideally allow sufficient time for DARPA and the awardee to review the awardee's initial transition plan, identify milestones to achieve under EEI, modify the award, and conduct the work required to achieve such milestones within the original award period of performance. These steps may take 18-24 months to complete, depending on the technology. If the DARPA PM determines that EEI could be of benefit to transition the technology to product(s) the Government needs, the PM will refer the performer to DARPA Commercial Strategy.

DARPA Commercial Strategy will then contact the performer, assess fitness for EEI, and in consultation with the DARPA technical office, determine whether to invite the performer to participate in the EEI. Factors that are considered in determining fitness for EEI include DoD/Government need for the technology; competitive approaches to enable a similar capability or product; risks and impact of the Government's being unable to access the technology from a sustainable source; Government and commercial markets for the technology; cost and affordability; manufacturability and scalability; supply chain requirements and barriers; regulatory requirements and timelines; Intellectual Property and Government Use Rights, and available funding.

Invitation to participate in EEI is at the sole discretion of DARPA and subject to program balance and the availability of funding. EEI participants' awards may be subsequently modified bilaterally to amend the Statement of Work to add negotiated EEI tasks, provide funding, and specify a milestone schedule which will include measurable steps necessary to build, refine, and execute a Go-to-Market technology transition plan aimed at delivering new capabilities for national defense. Milestone examples are available at: <https://www.darpa.mil/work-with-us/contract-management>.

Awardees under this solicitation are eligible to be considered for participation in EEI, but selection for award under this solicitation does not imply or guarantee participation in EEI.

7. Agency Contacts

Administrative, technical or contractual questions should be sent via e-mail to the mailbox listed below.

Points of Contact

The BAA Coordinator for this effort may be reached at:

Arcadia@darpa.mil

DARPA/BTO

ATTN: HR001121S0039

675 North Randolph Street

Arlington, VA 22203-2114

For information concerning agency level protests see <http://www.darpa.mil/work-with-us/additional-baa#NPRPAC>.

8. Other Information

DARPA will host a virtual Proposers Day in support of the Arcadia program on September 24, 2021. The purpose is to provide potential proposers with information on the Arcadia program, promote additional discussion on this topic, address questions, provide a forum to present their capabilities, and encourage team formation.

Interested proposers are not required to attend to respond to the Arcadia BAA, and relevant information and materials discussed at Proposers Day will be made available to all potential proposers in the form of a FAQ posted on the DARPA Opportunities Page.

DARPA will not provide cost reimbursement for interested proposers in attendance. An online registration form and various other meeting details can be found at the registration website, <https://events.sa-meetings.com/ArcadiaProposersDay>.

Participants are required to register no later than **September 21, 2021**. This event is not open to the Press. The Proposers Day will be open to members of the public who have registered in advance for the event; there will be no onsite registration.

Proposers Day Point of Contact:

Arcadia@darpa.mil

ATTN: DARPA-SN-21-40

9. APPENDIX 1 – Volume II checklist

Volume II, Cost Proposal Checklist and Sample Templates

The following checklist and sample templates are provided to assist the proposer in developing a complete and responsive cost volume. Full instructions appear in Section 4.2.2 of HR001121S0039. This worksheet must be included with the coversheet of the Cost Proposal.

1. Are all items from Section 4.2.2 (Volume II, Cost Proposal) of **HR001121S0039** included on your Cost Proposal cover sheet?

YES **NO** **Appears on Page(s)** [Type text]

If reply is “No”, please explain:

2. Does your Cost Proposal include (1) a summary cost buildup by Phase, (2) a summary cost buildup by Year, and (3) a detailed cost buildup of for each Phase that breaks out each task and shows the cost per month?

YES **NO** **Appears on Page(s)** [Type text]

If reply is “No”, please explain:

3. Does your cost proposal (detailed cost buildup #3 above in item 2) show a breakdown of the major cost items listed below:

Direct Labor (Labor Categories, Hours, Rates)

YES **NO** **Appears on Page(s)** [Type text]

Indirect Costs/Rates (i.e., overhead charges, fringe benefits, G&A)

YES **NO** **Appears on Page(s)** [Type text]

Materials and/or Equipment

YES **NO** **Appears on Page(s)** [Type text]

Subcontracts/Consultants

YES **NO** **Appears on Page(s)** [Type text]

Other Direct Costs

YES **NO** **Appears on Page(s)** [Type text]

Travel

YES **NO** **Appears on Page(s)** [Type text]

If reply is “No”, please explain:

4. Have you provided documentation for proposed costs related to travel, to include purpose of trips, departure and arrival destinations and sample airfare?

- YES** **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

5. Does your cost proposal include a complete itemized list of all material and equipment items to be purchased (a priced bill-of-materials (BOM))?

- YES** **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

6. Does your cost proposal include vendor quotes or written engineering estimates (basis of estimate) for all material and equipment with a unit price exceeding \$5000?

- YES** **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

7. Does your cost proposal include a clear justification for the cost of labor (written labor basis-of-estimate (BOE)) providing rationale for the labor categories and hours proposed for each task?

- YES** **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

8. Do you have subcontractors/consultants? If YES, continue to question 9. If NO, skip to question 13.

- YES** **NO** **Appears on Page(s)** [Type text]

9. Does your cost proposal include copies of all subcontractor/consultant technical (to include Statement of Work) and cost proposals?

- YES** **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

10. Do all subcontract proposals include the required summary buildup, detailed cost buildup, and supporting documentation (SOW, Bill-of-Materials, Basis-of-Estimate, Vendor Quotes, etc.)?

- YES** **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

11. Does your cost proposal include copies of consultant agreements, if available?

- YES** **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

12. If requesting a FAR-based contract, does your cost proposal include a tech/cost analysis for all proposed subcontractors?

- YES** **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

13. Have all team members (prime and subcontractors) who are considered a Federally Funded Research & Development Center (FFRDC), included documentation that clearly demonstrates work is not otherwise available from the private sector AND provided a letter on letterhead from the sponsoring organization citing the specific authority establishing their eligibility to propose to government solicitations and compete with industry, and compliance with the associated FFRDC sponsor agreement and terms and conditions.

YES **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

14. Does your proposal include a response regarding Organizational Conflicts of Interest?

YES **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain:

15. Does your proposal include a completed Data Rights Assertions table/certification?

YES **NO** **Appears on Page(s)** [Type text]

If reply is "No", please explain: