Broad Agency Announcement
Structures Uniquely Resolved to Guarantee Endurance (SURGE)

DEFENSE SCIENCES OFFICE

HR001124S0018

April 12, 2024

This publication constitutes a Broad Agency Announcement (BAA) as contemplated in Federal Acquisition Regulation (FAR) 6.102(d)(2) and 35.016 and 2 CFR § 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.

Overview Information:

- **Federal Agency Name** – Defense Advanced Research Projects Agency (DARPA), Defense Sciences Office (DSO)
- **Funding Opportunity Title –** Structures Uniquely Resolved to Guarantee Endurance (SURGE) Program
- **Announcement Type –** Initial Announcement
- **Funding Opportunity Number –** HR001124S0018
- **Assistance Listing Number:** 12.910 Research and Technology Development
- **Dates/Time - All Times are Eastern Time Zone (ET)**
  - Posting Date: April 12, 2024
  - Industry Day: April 18, 2024
  - Proposal Abstract Due Date: May 9, 2024, at 4:00 p.m.
  - Question Submittal Closed: June 13, 2024, at 4:00 p.m.
  - Proposal Due Date: July 1, 2024, at 4:00 p.m.

- **Anticipated individual awards** - Multiple awards are anticipated.
- **Types of instruments that may be awarded** - Procurement contracts, cooperative agreements, or Other Transactions for Prototype.
- **NAICS Code**: 541715
- **Agency contact**:
  - The BAA Coordinator for this effort may be reached at: SURGE@darpa.mil
    DARPA/DSO
    ATTN: HR001124S0018
    675 North Randolph Street
    Arlington, VA 22203-2114

Section I: Funding Opportunity Description

Introduction

The Defense Advanced Research Projects Agency (DARPA) is soliciting innovative proposals to rethink and accelerate distributed additive manufacturing of critical structural parts. Structures Uniquely Resolved to Guarantee Endurance (SURGE) will develop methods to predict part life directly from data collected during additive manufacturing (AM) in a way that is transferable across disparate machines, materials, locations, and geometries. Research will merge in-situ sensing technologies, process modeling, and microstructure-based fatigue life methods to quantify the useful life of manufactured hardware. Predictions will be backed by extensive experimental validation demonstrating a new paradigm for efficient part qualification. Proposed research must investigate innovative approaches that enable revolutionary advances in distributed AM capability. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice.

Background

The SURGE program aims to demonstrate an alternative path to the current machine-focused paradigm of part qualification in AM. Today, we work to perfect the operation of individual AM machines to repeatably produce material with known properties. This is accomplished through months or years of process optimization and material property testing at a cost that can easily surpass millions of dollars. This traditional approach to part qualification was borne out of a traditional manufacturing mindset – where relatively few machines produce identical parts at required production rates. SURGE will explore a new approach where the life of every unique manufactured component is predicted on the fly. If successful, this approach will unlock the full potential of AM for distributed production so that any part geometry can be produced on any machine, anywhere in the world, at any time, while guaranteeing part life under anticipated service conditions. SURGE will exploit the layer-by-layer nature of AM affording unprecedented material inspection as parts take shape. This ability to interrogate the complete part inside and out during production is unique to AM and opens new possibilities to predict part performance in real time at the point of manufacture. DARPA theorizes that in-situ AM inspection technologies may be at a sufficient level of maturity to digitally reconstruct part microstructure in concert with state-of-the-art process modeling methods. An accurate digital twin of part microstructure may then be exercised in microstructure-based fatigue life models to predict damage accumulation and crack propagation to failure. This approach to life prediction accounts for the *uniqueness of every part* and can be adapted for a range of anticipated usage scenarios. We envision a future where accurate part life predictions can be made based directly on data captured during AM, on a part-by-part basis, without the need for extensive prior process qualification. This would enable distributed AM for point-of-need production of critical parts and expand the potential defense industrial base in times of surge production demand.

Program Description and Scope

SURGE will explore the convergence of in-situ sensing technologies, process modeling, and microstructure-based fatigue life methods to predict the life of additively manufactured metallic parts in real time. A wide range of sensors are currently implemented in AM to collect thermal signatures, geometric information, acoustic feedback, and other process information to ensure that parts are built according to established conditions. This requires prior knowledge of the acceptable processing window to determine whether parts are inside (good) or outside (bad) of established bounds. In-situ monitoring approaches will continue to evolve and lead to improvements in AM, including closed-loop machine control, but the reliance on extensive prior knowledge is a significant shortcoming. SURGE is exploring an alternative approach by focusing on parts instead of process. SURGE will use in-situ data to generate a fingerprint of each part that includes details of the underlying microstructure. The aim is to produce the part's digital twin in near real time as the physical part is built. Existing sensor technologies must be combined in a framework that is machine-independent and transferable from machine to machine without requiring extensive machine manipulation. It is anticipated that data from multiple sensors will be collected and fused together to create a complete fingerprint of the part. It is recognized, however, that even state-of-the-art sensors are unlikely to yield microstructure-scale information directly, and new sensor development is explicitly out of scope on SURGE. To address this gap, SURGE will explore advanced AM and post-build process modeling to link data collected by the proposed sensor suite to fine-scale material features within a part that affect its useful life. Process modeling must be physics-based and account for the fundamental mechanisms of defect formation. Surrogate models can be invoked to accelerate model predictions but must be informed by the underlying physical phenomenon at play. This is to ensure that the methods developed are transferable, rather than applicable only to a specific machine or narrow set of conditions. The synergy of process modeling informed by in-situ manufacturing data should lead to an actionable digital representation of each part in the form of a defect and microstructure twin (DMT). The DMT will include all relevant life-limiting defects and microstructure features required to assess part performance for the proposed material system and AM method.

Using the captured DMT, SURGE will explore its application in microstructure-based fatigue life models to predict part failure. Microstructure-based lifing (MBL) will account for the nuances in each DMT to determine when and where critical flaws initiate and propagate to failure in parts subject to prescribed loading conditions. There are a spectrum of approaches that could be used, but all MBL predictions must be rooted in the fundamental physics of damage accumulation and fracture mechanics, explicitly linking the predicted failure mode to the microstructure and defect distribution within each part. DARPA anticipates that even the simplest geometries and loading conditions will contain competing failure modes initiating at different defects and/or propagating in multiple directions. The MBL prediction must account for all competing fatigue failures modes to determine the critical flaw and, subsequently, overall life of the part. Uncertainty of each prediction, stemming from underlying model assumptions and variable inputs, must also be quantified. MBL models will be executed for each manufactured part based on its unique DMT, providing a tailored prediction of part life. SURGE will include significant experimental testing to validate the accuracy of MBL predictions. Performers and Government Independent Verification and Validation (IV&V) teams will test simple coupons and complex component geometries manufactured over a range of processing conditions and exercised over a variety of loading scenarios to generate comprehensive datasets.

If successful, SURGE will convincingly demonstrate an alternative approach to qualification for parts produced by AM. The SURGE paradigm shift revolves around the ability to predict life on a part-by-part basis at the point of manufacture as opposed to traditional approaches that rely on the statistics of material produced using fixed processes. Shifting focus from process to part represents a fundamental change in lifing practices that will lead to greater flexibility in manufacturing. As SURGE relies only on data collected during manufacturing, accurate life prediction should be possible across a range of machines and materials – even those where the operator may have little or no prior experience or a recipe of qualified processing conditions. The SURGE program will unlock the full potential of AM to become a truly distributed production method for point-of-need manufacturing and surge production readiness.

Program Structure

SURGE proposals must be structured as a 24-month Phase 1 base with an option for a 24-month Phase 2 effort. Phase 1 will focus on fundamental method development and experimental validation while Phase 2 will apply developed methods to complex parts, demonstrate transferability, and drive stakeholder transition.

In Phase 1, performers will demonstrate:

1. A standalone AM data collection scheme including optimization of the number, type, and position of sensors to collect data during manufacturing
2. Modeling methods to generate a DMT based on the data collected during manufacturing
3. MBL predictions executed on the DMT quantifying expected test coupon life with estimated uncertainty
4. Experimental validation testing to prove DMT and MBL model accuracy
5. Initial transferability of developed methods across different feedstocks and machines

Proposing teams must bring together expertise across all necessary disciplines and propose a holistic program that addresses all 5 points above. Proposals that do not address all required areas may be deemed nonconforming.

In Phase 2, DARPA will issue two “challenge” part designs based on performer material and manufacturing approach. Performers will apply methods developed in Phase 1 to predict part life and failure mode. Predictions must be validated through performer-led component-level testing. Transferability will also be tested in collaboration with SURGE IV&V partners. Performers will work with IV&V teams to replicate in-situ sensing and modeling tools on-site at IV&V facilities. This will involve the physical transfer of equipment and software along with training of IV&V personnel. Transferability will be confirmed if the IV&V teams successfully reproduce performer results on their machines per the program metrics described in the next section. Component-level testing will be performed by IV&V teams on parts produced on their machines for validation. Finally, Phase 2 culminates in the drafting of technical specifications detailing newly developed approaches to part qualification for AM. Performers will be expected to work in close collaboration with Government stakeholders to draft specifications based on their developed methods.

Figure 1 includes a high-level overview of the program schedule and major milestones. In addition to the technical work in Phases 1 and 2, multiple stakeholder updates will be held throughout the program shown as standalone meetings or co-located events at relevant technical conferences. Performers will brief key results at these meetings to keep Government stakeholders apprised of new developments and solicit feedback to assist future technology adoption. Public presentations and publications will also be encouraged after the first year of the program to build technical consensus and spur parallel efforts (content will be cleared for public release by DARPA, as needed). DARPA will also work with potential transition partners throughout the program to draft a memorandum of agreement (MOA) for continued development and application of SURGE methods in a production environment. Initial drafts of the MOA(s) will be complete by the end of Phase 1 with the intent to finalize at least one agreement by the end of the program. Performers will provide technical input to inform the MOA, but drafting of the agreement and coordination with stakeholders will be the sole responsibility of DARPA.

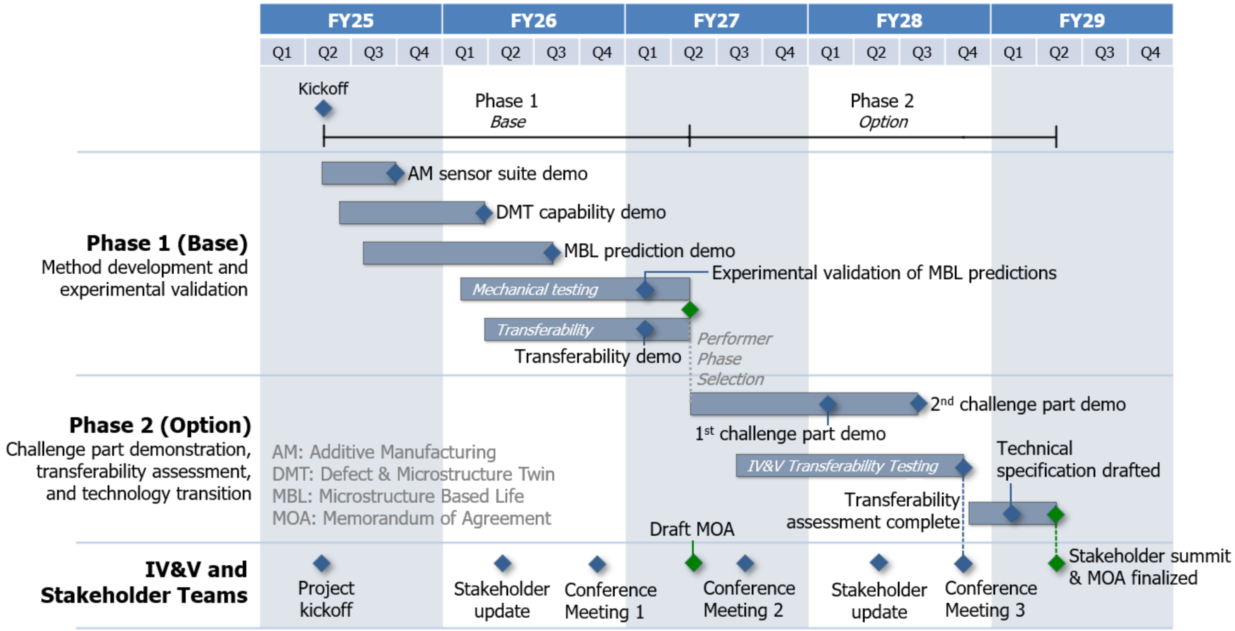


Figure 1: SURGE program schedule

Program Metrics

SURGE program metrics (Figure 2) are organized into three categories – speed, accuracy, and transferability.

	Phase 1	**Phase 2**
Speed	☐ **<24h** to generate DMT ☐ **<12h** for MBL prediction	☐ **<12h** to challenge part life prediction [e]
Accuracy	☐ 90% POD defects **>25μm** [a] ☐ Average grain size within **50%** [b] ☐ Mean MBL prediction within **30%** of experimentally measured life [c]	☐ Mean MBL prediction within **40%** of experimentally measured life [c] ☐ Predicted crack initiation site within **5mm** of experiment [f]
Transferability	☐ **2** feedstock suppliers [d] ☐ **2** different machines	☐ **2** different alloys [d] ☐ **1+** machine at external IV&V site

[a] Major diameter of model-predicted defects relative to an established experimental characterization technique (e.g., X-ray tomography, serial sectioning). Defect position(s) must be mapped with an accuracy of ≤5x the major diameter distance of each defect.
[b] Must include both major and minor length for elongated grain structures having an aspect ratio >2:1 (e.g., build and transverse directions).
[c] Demonstrated with 90% confidence by testing at least ten (10) specimens per condition. A complete MBL model prediction with quantified uncertainty must be calculated for each individual specimen based on its unique DMT.
[d] Life prediction method must be demonstrated on the same nominal alloy procured from at least two (2) different feedstock suppliers (vendors) in Phase 1. In Phase 2, life prediction for an additional alloy must be demonstrated. The second alloy can be in the same class as the first.
[e] Challenge parts for Phase 2 will be assigned by DARPA during Phase 1 based on performer manufacturing capabilities. Time is measured from part build completion to computational life prediction.
[f] Average distance between model predicted and experimentally observed crack initiation site based on at least ten (10) component-level tests; critical microstructure feature(s) initiating failure must be identified in the MBL model and agree with experimental observations.

Figure 2: SURGE program metrics

Speed

Speed is defined as the time between the completion of an AM build and the output of a final model prediction using a typical engineering workstation. A typical workstation is defined here as a computer designed for technical engineering analysis that can be readily purchased off-the-shelf. Proposals must include a detailed description of the planned compute resources. In Phase 1, the DMT must be output in less than 24 hours and the subsequent MBL prediction, based on the DMT, must run to completion in less than 12 hours (wall times). Note that any time required for initial, nonrecurring model parameterization and/or training (if applicable) is not subject to these time limits. This could include upfront time for physics-based simulations, tuning of hyperparameters in a machine learning model, calibration of constants in a constitutive model, or a number of other preparatory activities to dial in the DMT and MBL predictions. However, the 24-hour DMT and 12-hour MBL thresholds must be satisfied at or before the program capability demonstration milestones denoted in the program schedule (Figure 1). In Phase 2, speed is simply defined as the time between AM build completion and the output of a final part life prediction, inclusive of DMT and MBL run times. Phase 2 life prediction must be demonstrated on DARPA-provided challenge part designs which will be developed and delivered to performers toward the end of Phase 1. Challenge part designs will be compatible with performer manufacturing methods, materials, and testing capabilities.

Accuracy

Accuracy metrics in Phase 1 are focused on DMT and MBL predictions. The DMT must include relevant defect and microstructural details for the proposed material and manufacturing method to inform follow-on physics-based MBL predictions. Key defects of interest include the distribution of voids, inclusions, and cracks within a part, along with other deleterious features such as surface roughness. SURGE requires a 90% probability of detecting (POD) all defects greater than 25μm in size to ensure adequate sampling for MBL predictions. As defined in Figure 2, footnote 'a', size is defined as the major diameter of a defect (or length in the case of cracks) and the position of each defect must be mapped with an accuracy of less than five (5) times the major diameter distance of the defect. The 90% POD threshold is defined relative to a proposed experimental baseline. In other words, at least nine (9) out of ten (10) defects detected experimentally must have been predicted a priori in the DMT using only data collected during manufacturing. This definition of POD is not to be confused with the rigorous statistical methods defined for non-destructive test evaluation (e.g., MIL-HDBK-1823A). Rather, it is intended to demonstrate early proof-of-concept for approaches developed on SURGE.

The DMT must also include details of the grain structure that will influence the initiation and propagation of fatigue cracks. SURGE requires average grain size prediction in the DMT with at least 50% accuracy relative to experimental measurements. Where grain shapes are significantly elongated (defined here as an aspect ratio greater than 2:1), both the major and minor lengths must be reported. The 50% grain size metric is an average and must include sampling across at least three (3) regions of performer-defined test coupons spanning the finest and coarsest locations. Each region must include predictions for both build and transverse orientations. This is particularly important in situations where grain size and shape may vary throughout a component geometry due to local thermal history. Test coupons and/or manufacturing parameters must be proposed that mimic a wide range of thermal variation. In addition to grain size, other potential life-limiting microstructural features must also be included in the DMT specific to the proposed material and AM method. Proposals must describe the critical microstructural inputs to the MBL model and how the selected features will be sufficient to achieve SURGE life prediction goals.

Performers must validate DMT accuracy for both defects and grain size by comparing directly to experimental characterization conducted on the same volume of material using existing destructive or non-destructive techniques. Minimum sample dimensions of 1cm x 1cm x 0.5cm are required for validation. Proposals must include experimental characterization techniques that are capable of detecting defects as small as 25µm to serve as a reliable baseline. Proposals must also include a detailed characterization plan to measure local grain size and compare to DMT predictions.

The final Phase 1 accuracy metric in Figure 2 requires MBL predictions within 30% of experimentally measured values. Accuracy must be demonstrated with at least 90% confidence by testing at least ten (10) specimens per condition. Conditions refer to the AM build parameters used to produce the test specimens and the fatigue test conditions (see the Program Requirements section below for more detail). In traditional fatigue testing campaigns, a large population of specimens are tested to generate a statistical representation of fatigue life. The results are analyzed to generate design allowables (e.g., A-basis, B-basis, S-basis) representing the *lowest* fatigue performance of the material with some statistical guarantee. SURGE is exploring a different approach. If an accurate DMT can be generated for each test specimen, and MBL methods properly account for the defects and microstructure within the specimen, then an explicit life prediction should be possible for that specimen. A key hypothesis on SURGE is that accurate fatigue life predictions can be made based on explicit, rather than statistical or implicit, representation of materials. Therefore, the 30% MBL accuracy metric in Figure 2 must be demonstrated on a test-by-test basis. Each specimen will have a unique DMT driving a unique MBL prediction. Uncertainty must be quantified for the MBL prediction, accounting for underlying model assumptions and other variable inputs, but the average value will be compared to experiment. The average MBL prediction must match the experimentally measured fatigue life within 30% for at least nine (9) out of ten (10) tests conducted. Proposals must detail how the experimental fatigue life will be assessed – cycles to initiation, failure, or other reliable indicator.

In Phase 2, the MBL prediction accuracy metric increases to 40% to account for increased challenges in predicting the life of more complex part geometries (relative to simple test specimens in Phase 1). The same 90% confidence requirement holds – performers must demonstrate 40% accuracy in life prediction on at least nine (9) out of ten (10) parts tested for each condition. The second accuracy metric in Phase 2 requires prediction of the main (fatal) crack initiation site within 5mm of the experimentally observed location on the part. Furthermore, as indicated in Figure 2, footnote 'f', the microstructure feature(s) responsible for failure must also be identified in the MBL model and agree with fractography observations following component-level testing. Different failure initiation sites are anticipated due to varying AM processing conditions and component-level loading parameters. While DMT accuracy metrics are not explicitly tracked in Phase 2, it is expected that the level of accuracy established in Phase 1 will be necessary to meet the MBL prediction and crack initiation location criteria.

Transferability

The final SURGE metric category is transferability. In Phase 1, performers must demonstrate speed and accuracy metrics for a set of conditions (process and test) selected by DARPA on feedstock materials procured from two (2) different suppliers/vendors and on two (2) different AM machines. Feedstock in Phase 1 (e.g., powder, wire, rod, etc.) must be the same nominal alloy purchased from or produced by two different suppliers. While DARPA expects that both feedstock materials will fall within an established specification, DMT and MBL predictions must capture any subtle differences in chemistry, size, shape, etc., that are allowable within the specification limits. The approach must also be demonstrated on two (2) different AM machines. The machines can be the same make and model, and can be co-located at a single performer site, but must be distinct machines with different serial numbers. Demonstrating the speed and accuracy metrics on machines of two (2) different makes and/or models, and at different site locations, is also acceptable. In Phase 2, transferability must be proven across two (2) different alloys and on one (1) or more AM machines located at an external IV&V site. The alloys can be within the same class (e.g., stainless steel, aluminum, titanium, nickel-based) and rely on the same strengthening mechanisms but must carry distinct Unified Numbering System (UNS) designations. Proposers are encouraged to submit clearly distinct alloys (e.g., 316 and 316L stainless would not be a compelling demonstration of transferability). The SURGE Government IV&V team will be responsible for testing and verifying transferability in Phase 2 on AM machines located within their facilities. Performers will work with a selected IV&V partner to reproduce the entire SURGE workflow from in-situ sensor placement to DMT and MBL prediction. Independent testing conducted at the IV&V site will be used to establish the transferability of performer-developed methods. This is a critical part of the SURGE program to enable successful future transition to stakeholders.

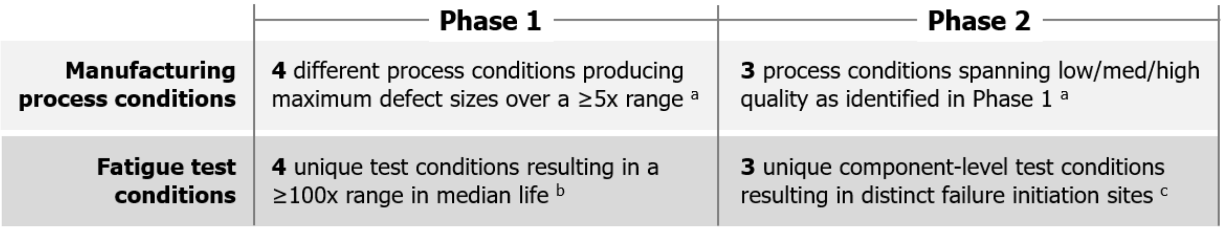
Program Requirements

SURGE is focused on part life prediction to disrupt the current AM part qualification paradigm for established metal alloys using existing sensor technology. Alloy development and new sensor development are out of scope. Proposals including new materials that are difficult to source commercially will be considered non-responsive. Alloy classes and specific alloys listed below are provided as examples of in-scope materials, but other common materials are also encouraged:

- Stainless steel: 316L, 304, 17-4PH
- Titanium: Ti-6Al-4V, Ti-6Al-2Sn-4Zr-2Mo, CP Ti
- Aluminum: 6061, 2024, AlSi7Mg
- Nickel-based: Inconel 718, Hastelloy X, Alloy 230

SURGE is open to a wide range of AM techniques capable of producing structural metallic hardware. Acceptable techniques include, but are not limited to, laser powder bed fusion, wire or powder-fed directed energy deposition, cold spray, friction stir deposition, and wire arc additive manufacturing.

Figure 3 (below) outlines ranges in processing and test conditions over which the metrics detailed in the previous section must be demonstrated. This is to ensure that SURGE-developed methods are broadly applicable. Manufacturing process conditions in Phase 1 must be varied over a wide range resulting in at least a 5x difference in maximum material defect size. The intent is to produce both material that is high quality (inside an established processing window) and low quality (outside the window). Depending on the specific AM modality proposed, this may involve changing the deposition energy, speed, pattern, etc. Fatigue tests must be conducted across four (4) different manufacturing process conditions in Phase 1 and three (3) conditions in Phase 2. The fatigue test conditions (e.g., strain/stress range, load or strain ratio, frequency, temperature) must be fixed and chosen to yield a statistically significant range in life as a result of the manufacturing process conditions.



	Phase 1	**Phase 2**
Manufacturing process conditions	**4** different process conditions producing maximum defect sizes over a ≥5x range [a]	**3** process conditions spanning low/med/high quality as identified in Phase 1 [a]
Fatigue test conditions	**4** unique test conditions resulting in a ≥100x range in median life [b]	**3** unique component-level test conditions resulting in distinct failure initiation sites [c]

[a] Intent is to validate life predictions across low to high quality material produced inside/outside an optimal processing window at a <u>single fatigue test condition</u>.
[b] Test a range of loading conditions at performer-selected temperature(s) at a <u>single manufacturing process condition</u>.
[c] Varying load direction & amplitude to produce unique stress distribution and crack initiation sites located >20mm from each other.

Figure 3: SURGE program requirements.

The second row in Figure 3 includes requirements for fatigue testing over a wide range of conditions on material produced using a fixed process. Fatigue tests must span from aggressive to relatively benign resulting in at least 100x variation in median life in Phase 1. In Phase 2, conditions must be chosen to drive component failure at three (3) different initiation sites. The overarching goal of the requirements listed in Figure 3 is to ensure that SURGE-developed methods are applicable across a wide range of conditions. Proposals must detail anticipated manufacturing process conditions and fatigue test conditions for the proposed manufacturing method and alloy class. Note that fatigue tests on the SURGE program can all be conducted at a single performer-selected temperature, or a range of proposed temperatures. In either case, approaches to include temperature dependence in the MBL prediction must be discussed.

Other requirements and considerations for SURGE include the following:

- Hot or cold isostatic pressing (HIP, CIP) after AM is not allowed and should not be included in proposals.
- Conventional heat treatments for stress relieving, solutioning, ageing, tempering, etc., are encouraged, as appropriate for the proposed materials, and must be included in the life prediction workflow. The impact of heat treatment on the DMT collected during manufacturing must be accounted for and included in the MBL prediction.
- Machining, grinding, and other conventional surface treatments (e.g., shot peening) are allowed and, if proposed, must be included in the DMT and MBL predictions. Proposers are *strongly encouraged* to consider machined/surface ground test specimens in Phase 1 to reduce as-processed surface-driven effects. Depending on the AM modality proposed, methods developed on SURGE should be capable of predicting the life of arbitrarily shaped components that include a combination of as-built and machined surfaces – challenge parts in Phase 2 will likely contain both.
- DMT's must include relevant unique characteristics for the selected materials and AM process; for example, secondary phase size and morphology in multi-phase alloys and specific process-induced defects.
- Sensor packages developed on SURGE must be standalone and readily transferrable between different machines. Minor machine manipulation to integrate sensors in or around the build volume is acceptable but must not interfere with or alter the original operation of the machine. Existing onboard machine signals can also be used as part of the in-situ data collection strategy (e.g., power feedback, vacuum levels, etc.).

Schedule and Milestones

Proposals must include a technical and programmatic strategy that conforms to the entire program schedule for Phases 1 (Base) and 2 (Option) as outlined in Figure 1. Proposals must fully address program goals, metrics, milestones, and deliverables. Pertinent milestone details are as follows:

- Proposers may assume a start date of February 3, 2025, for planning purposes.
- 5 months following contract award (FCA) (Base): Performers will demonstrate a sensor suite capable of capturing data during AM to inform the DMT.
- 10 months FCA (Base): Performers will demonstrate the ability to produce accurate DMT's per SURGE metrics and requirements.
- 14 months FCA (Base): Performers will demonstrate the ability to generate MBL predictions of test specimen life per SURGE metrics and requirements.
- 21 months FCA (Base): Performers will experimentally validate MBL predictions and demonstrate method transferability per SURGE metrics and requirements.
- 33 months FCA (Option): Performers will demonstrate life prediction on a challenge part per SURGE metrics and requirements.
- 39 months FCA (Option): Performers will demonstrate life prediction on a second challenge part per SURGE metrics and requirements.

- 42 months FCA (Option): Transferability of performer-developed methods will be confirmed at an IV&V facility.
- 45 months FCA (Option): Performers will draft a technical specification(s) covering the complete method for life prediction.
- 48 months FCA (Option): Performers will present final program results at a stakeholder summit meeting.

All proposals must also include the following meetings and travel in the proposed schedule and costs:

- (Base) A two-day project kickoff meeting to be held in Arlington, VA in mid-February 2025.
- One-day stakeholder update meetings to be held in Arlington, VA on or around January 2026 (Base), February 2028 (Option), and January 2029 (Option).
- Three (3) one-day Principal Investigator (PI) meetings held in conjunction with domestic technical conferences, one each year in 2026 (Base), 2027 (Option), and 2028 (Option). For planning purposes, proposers can assume conferences will be held in Washington, DC (2026), Orlando, FL (2027), and San Diego, CA (2028)
- Monthly virtual meetings (Base & Option) will be scheduled with DARPA and the IV&V teams for progress reporting as well as identification and mitigation of technical and programmatic challenges.
- Proposers should anticipate at least one site visit per phase (Base & Option) by the DARPA Program Manager and/or IV&V team during which performers should provide laboratory tours and demonstrations that illustrate progress toward program milestones and metrics.

Deliverables

Performers will be expected to provide at a minimum the following deliverables throughout Phase 1 (Base) and 2 (Option):

- Comprehensive quarterly technical reports due within fifteen days of the end of the given quarter, describing progress made on the specific milestones as required in the statement of work (SOW).
- Monthly technical and financial reports (monthly technical reports can be delivered via a slide presentation).
- A phase completion report submitted within 30 calendar days of the end of each phase summarizing the research done.
- Sensor package hardware and modeling/analysis software to test life prediction method transferability at Government IV&V sites.
- Hardware and software, as requested, that may include engineering drawings, operating methods and instructions, software, datasets, material samples, and/or entire developed experimental capabilities.
- Other negotiated deliverables specific to the objectives of the individual effort. These may include registered reports; experimental protocols; publications; data management plan; intermediate and final versions of software libraries, code, and APIs, including documentation and user manuals; and/or a comprehensive assemblage of design documents, models, modeling data and results, and model validation data.

Section II: Evaluation Criteria

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

- **Overall Scientific and Technical Merit:**
  The proposed technical approach is innovative, feasible, achievable, and complete. Detailed technical rationale is provided delineating why the proposed approach can achieve the program goals and metrics. The proposed technical team has the expertise and experience to accomplish the proposed tasks. Task descriptions and associated technical elements provided are complete and logically sequenced with all proposed deliverables clearly defined so the final outcome of the award's work achieves the goal. The proposal identifies major technical risks, and planned mitigation efforts are clearly defined and feasible.

- **Potential Contribution and Relevance to the DARPA Mission:**
  The potential contributions of the proposed effort bolster the national security technology base and support DARPA's mission to make pivotal early technology investments that create or prevent technological surprise. The proposed intellectual property restrictions (if any) will not significantly impact the Government's ability to transition the technology.

- **Cost and Schedule Realism:**
  The proposed costs and schedule are realistic for the technical and management approach and accurately reflect the technical goals and objectives of the solicitation. All proposed labor, material, and travel costs are necessary to achieve the program metrics, 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). The proposed schedule aggressively pursues performance metrics in an efficient time frame that accurately accounts for the anticipated workload.

  It is expected the effort will leverage all available, relevant, prior research to obtain the maximum benefit from the available funding. For proposals containing cost share, the proposer has provided sufficient rationale regarding the appropriateness of the cost share arrangement, relative to the objectives of the proposed solution (e.g., high likelihood of commercial application, etc.).

- Unless otherwise specified in this announcement, for additional information on how DARPA reviews and evaluates proposals through the Scientific Review Process, please visit: Proposer Instructions: General Terms and Conditions.

Section III: Submission Information

- This announcement allows for multiple award instrument types to be awarded to include Procurement Contracts, Cooperative Agreements, and Other Transactions for Prototype. Some award instrument types have specific cost-sharing requirements. The following websites are incorporated by reference and contain additional information regarding overall proposer instructions, general terms and conditions, and each specific award instrument type.
    - **Proposer Instructions and General Terms and Conditions**: Proposer Instructions: General Terms and Conditions
    - **Procurement Contracts**: Proposer Instructions: Procurement Contracts
    - **Cooperative Agreements**: Proposer Instructions: Grants/Cooperative Agreements
    - **Other Transaction agreements**: Proposer Instructions: Other Transactions
- This announcement contains an abstract phase. Abstracts are due May 9, 2024, at 4:00 p.m. as stated in the Overview section. Abstracts are strongly encouraged but not required. Additional instructions for abstract submission are contained within **Attachments A and B**. (Regardless of instrument type desired, all abstracts must be submitted through the Broad Agency Announcement Tool (BAAT.) For detailed information on how to submit to BAAT, visit the "Unclassified Submission Instructions" section at Proposer Instructions: General Terms and Conditions.
- Full proposals are due July 1, 2024, at 4:00 p.m. as stated in the Overview section.
- **Attachments C, D, E, and F** contain specific instructions and templates and constitute a full proposal submission for proposers requesting either a Procurement Contract or Other Transactions for Protoype.
- **Attachments C, D, and F** contain specific instructions and templates and constitute a full proposal submission for proposers requesting a Cooperative Agreement.
- Please visit Proposer Instructions: General Terms and Conditions for general Terms and Conditions for all requested contract types. Visit Proposer Instructions: Procurement Contracts for submission instructions for proposers requesting Procurement Contracts. Visit Proposer Instructions: Other Transactions for submission instructions for proposers requesting Other Transactions. Visit Proposer Instructions: Grants/Cooperative Agreements for submission instructions for proposers requesting Cooperative Agreements. (Proposers requesting Procurement Contracts or Other Transactions for Prototype must submit proposals through the Broad Agency Announcement Tool. If requesting a Cooperative Agreement proposals must be submitted through grants.gov.)

- **BAA Attachments**:
    - **(required) Attachment A**: Abstract Summary Slide Template
    - **(required) Attachment B**: Abstract Instructions and Template
    - **(required) Attachment C**: Proposal Summary Slide Template
    - **(required) Attachment D**: Proposal Instructions and Volume I Template (Technical and Management)
    - **Attachment E**: Proposal Instructions and Volume II Template (Cost) **(required for proposers requesting Procurement Contracts or Other Transactions for Prototype)**
    - **(required) Attachment F**: MS Excel^{TM} DARPA Standard Cost Proposal
    - **Attachment G**: SURGE CUI Guide

Section IV: Special Considerations

- This announcement, stated attachments, and websites incorporated by reference constitute the entire solicitation. In the event of a discrepancy between the announcement, attachments, or websites, the announcement takes precedence.

- All responsible sources capable of satisfying the Government's needs, including both U.S. and non-U.S. sources, may submit a proposal DARPA will consider. Historically Black Colleges and Universities, small businesses, small disadvantaged businesses, and minority institutions are encouraged to submit proposals and join others in submitting proposals; however, no portion of this announcement will be set aside for these organizations' participation due to the impracticality of reserving discrete or severable areas of this research for exclusive competition among these entities. 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.

- As of the time of publication of this solicitation, all proposal submissions are anticipated to be unclassified.

- FFRDCs, UARCs, and Government entities interested in participating in the SURGE program or proposing to this BAA should first contact the agency point of contact listed in the Overview section prior to the abstract due date to discuss eligibility. Complete information regarding eligibility can be found at Proposer Instructions: General Terms and Conditions.

- DARPA's Fundamental Research Risk-Based Security Review Process (formerly CFIP) is an adaptive risk management security program designed to help protect the critical technology and performer intellectual property associated with DARPA's research projects by identifying the possible vectors of undue foreign influence. DARPA will create risk assessments of all proposed senior/key personnel selected for negotiation of a fundamental research grant or cooperative agreement award. The SID risk assessment process will be conducted separately from the DARPA scientific review process and adjudicated prior to final award. For additional information on this process, please visit Proposer Instructions: Grants/Cooperative Agreements.

- As of the date of publication of this solicitation, the Government expects program goals as described herein may be met by proposed efforts for fundamental research and non-fundamental research. Some proposed research may present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies unique and critical to defense. Based on the anticipated type of proposer (e.g., university or industry) and the nature of the solicited work, the Government expects some awards will include restrictions on the resultant research requiring the awardee seek DARPA permission before publishing any information or results relative to the program. For additional information on fundamental research, please visit Proposer Instructions: General Terms and Conditions.
- 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 Proposer Instructions: General Terms and Conditions.
- For certain research projects, it may be possible that although the research to be performed by a potential awardee is non-fundamental research, their proposed subawardee's effort may be fundamental research. It is also possible the research performed by a potential awardee is fundamental research while their proposed subawardee's effort may be non-fundamental research. In all cases, it is the potential awardee's responsibility to explain in their proposal which proposed efforts are fundamental research and why the proposed efforts should be considered fundamental research.
- DARPAConnect offers free resources to potential performers to help them navigate DARPA, including "Understanding DARPA Award Vehicles and Solicitations," "Making the Most of Proposers Days," and "Tips for DARPA Proposal Success." Join DARPAConnect at www.DARPAConnect.us to leverage on-demand learning and networking resources.
- DARPA has streamlined our BAAs and is interested in your feedback on this new format. Please send any comments to DARPAsolicitations@darpa.mil.