IARPA

DRAFT

BROAD AGENCY ANNOUNCEMENT

FUNDING OPPORTUNITY DESCRIPTION

**Smart Electrically Powered and Networked Textile Systems
(SMART ePANTS)
Program**

Release Date: TBD

INSTRUCTIONS

This Draft Broad Agency Announcement (BAA) is NOT a formal request for proposal. Proposals are NOT being requested or evaluated at this time. A Final BAA will be released at a later date for which interested parties may submit proposals.

The Intelligence Advance Research Projects Activity (IARPA) is seeking interested parties to thoroughly review this Draft BAA Funding Opportunity Description and provide comments, questions, suggested changes, and feedback by 5pm EDT on **Friday, May 13, 2022** in the format provided below.

IARPA does not anticipate posting responses to any comments, questions, suggested changes, and/or feedback received; however, all input will be considered in developing the Final BAA. Additionally, this Draft BAA Funding Opportunity Description is subject to change in the development of the Final BAA as a result of IARPA's consideration of the input received from interested parties in response to the Draft BAA.

Please submit all comments, questions, suggested changes, and feedback to the designated procurement email address: dni-iarpa-SMARTePANTS-proposersday@iarpa.gov using the below format.

Interested parties will be given the opportunity to submit questions and comments in writing for IARPA response once the Final BAA is issued.

COMMENT SHEET FOR DRAFT Broad Agency Announcement for SMART ePANTS				
#	BAA Section/Sub-Section	Subject/Title	Page Number	Contractor Comment/Question
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1. FUNDING OPPORTUNITY DESCRIPTION:

The Intelligence Advanced Research Projects Activity (IARPA) often selects its research efforts through the BAA process. The use of a BAA solicitation allows a wide range of innovative ideas and concepts. The BAA will appear on https://sam.gov/, Contract Opportunities, on the NAVWAR Contracts Directorate Website (https://e-commerce.dc3n.navy.mil/), and the IARPA website at http://www.iarpa.gov/. The following information is for those wishing to respond to this Program BAA.

This BAA is for the Smart Electrically Powered and Networked Textile Systems (SMART ePANTS) program. The Government is seeking innovative solutions for the SMART ePANTS program in this BAA.

1.A.   Program Overview

Intelligence Community (IC) and Department of Defense (DoD) missions often require sensor systems that can collect and communicate critical information on staff members' location and surroundings when they are working in dangerous or high stress environments. In these scenarios, mission safety and effectiveness are reduced when users are distracted by using the sensor system, just as taking a phone call or reading a text reduces safety when driving a vehicle. In IC and DoD missions however, distracted work can lead to serious national security risks.

Consider, for example on-site arms control inspections performed at nuclear fuel enrichment facilities, or at chemical manufacturing plants that are under monitoring by international organization procedures such as those of the International Atomic Energy Agency (IAEA), the Organization for the Prohibition of Chemical Weapons (OPCW) or the United Nations Monitoring Verification and Inspection Commission (UNMOVIC) for Iraq. During these missions, inspectors tour facilities replete with safety hazards, reach into cramped spaces to take samples, and pore over data presented to them on computer screens or on paper. The recorded audio and video data, and the location where the information was gathered is critical to mission success. However, if inspectors are distracted from their duties, or experience an impaired range of motion from carrying or wearing bulky equipment, personal injury or incomplete data gathering can occur. In an on-site inspection scenario, such incidents can lead to reduced confidence in arms control inspection integrity, eroding the effectiveness of international organizations to help avoid conflict.

Development of comfortably worn Active Smart Textile (AST)[1] garments for use in situations like on-site arms control inspections is the objective of IARPA's new Smart electrically Powered And Networked Textile Systems (SMART ePANTS) program. For maximum comfort and dexterity of the user, additional program objectives include sensor integration into clothing, where the garment maintains similar stretchability, bendability, surface roughness and washability attributes to a comparable garment containing no sensor. SMART ePANTS sensor systems must also be safely worn against the skin, be reusable, and be capable of exporting the data they gather to an external

---

[1] Active smart textiles (ASTs) are fabrics that are designed to adapt and change their functionality in response to changes in their external environment or user input. Unlike passive smart textiles (PST) such as Gore-Tex™ which rely on their physical structure to function, ASTs employ energy to power built-in sensors and/or actuators that sense, store, interpret or react to information from their environment. The definition employed to differentiate active and passive smart textiles may be found on the Loomia website: https://www.loomia.com/blog/passive-vs-active-smart-textiles (accessed July 17, 2021).

data storage device (such as a computer hard drive). It is expected that the sensor systems will be entirely incorporated into garment components, especially fibers, yarn and fabric, but may include (to a limited extent) expected commercial (i.e., currently available for sale) garment accessories such as buttons, grommets, zippers, piping or collar stays.

Like all interactive electronic devices, the ASTs developed under the SMART ePANTS program comprise four components: (1) a sensor(s) to gather information; (2) a computation and data storage unit; (3) a power source; and (4) interconnects that enable device operation. ASTs developed under this BAA shall be integrated to collect audio, video and/or indoor location data using a system comprising these four components. IARPA expects that these components will be distributed throughout the garment to maximize the use of the 2-3 m^2 of textile that most people wear to work. Detailed information about specific goals, objectives, metrics, and milestones can be found in Section 1.F Program Metrics.

1.A.1. Research Tracks

Proposals must fully describe the Offeror's technical approaches to address one or more of the following Research Tracks. Proposals must describe a plan to develop an AST built into a "primary garment" (defined as shirts, blouses, pairs of pants, dresses, socks, undergarments,[2] or swimwear). For this BAA, "integrated" means that all the required system components (the sensor, power source, computer and data storage, wires, switches, and other interconnects) have been assembled to work together, and that the system can record data from its environment as described in one or more of the following three research tracks:

Track 1: Audio (Hear It) – Develop an integrated system that can record a conversation between two or more people.

Track 2: Video/Photography (See It) – Record photographs and/or video under indoor office or factory conditions.

Track 3: Location (Locate It) – Record three-dimensional location data indoors relative to a starting point.

SMART ePANTS performance criteria for each Track are provided in this BAA, Section 1.E.1. Performance Criteria: Sensing Events.

1.A.2. Program Phases

The SMART ePANTS program will proceed in three phases that are designed to give Offerors time to explore potentially more speculative solutions early on while requiring more durable operational prototypes in Phases 2 and 3. More detail on technical metrics to be met for this BAA can be found in Section 1. F. Program Metrics. The following paragraphs introduce the program phases:

---

[2] Undergarments include any kind of men's or women's underwear, including bras, slips, jockstraps or other garments worn close to the skin.

Phase 1: System Integration (Build It) – Phase 1 will last 18 months and will focus on the viability of the Offeror's proposed AST building approach. Offerors are required to develop a reusable, flexible, stretchable integrated AST that may be tested for the sensing events and comfort performance parameters summarized in Table 1 of this BAA. To perform the listed stretch and bend testing for Phase 1, all AST components must be integrated and attached to a stretchable, bendable substrate that transfers the mechanical stress conferred during testing. Exercise of the option to continue with the SMART ePANTS program into Phase 2 will consider a thorough, independent evaluation of the Offeror's submitted sensor system, and a plan for incorporation into a garment.

Phase 2: Garment Integration (Wear It) – Phase 2 will last 12 months and will focus on the development of a functional prototype AST that is woven, knitted, embroidered, or otherwise incorporated into a prototype garment that resembles a commercially available reference garment provided by the Offeror, as defined by metrics for stretch, bend, compression, surface roughness, wash, and breathability. At this point in the program, it is expected that the integrated garment shall be able to perform sensing events before, during and after the strains resulting from comfort and durability testing. Exercise of the option to continue with the SMART ePANTS program into Phase 3 will consider the ability of the Offeror's submitted garment to meet Phase 2 AST metrics and a plan for meeting all final program metrics.

Phase 3: Garment Comfort and Durability (Wash It) – Phase 3 will last 12 months and will focus on the development of a functional prototype garment capable of meeting all final program metrics for the selected research Track, including AST performance, garment comfort, durability, and washability.

1.B.   Team Expertise

Collaborative efforts and teaming among Offerors are highly encouraged. It is anticipated that Offeror teams will be multidisciplinary and may include expertise and experience in multiple fields related to SMART ePANTS program goals.

1.C.   Program Scope and Limitations

Proposals shall explicitly address the following:

- **Integration Concept:** Proposed strategies to meet program-specified metrics must have firm theoretical bases that are described with sufficient detail that reviewers will be able to assess the viability of using project components, both separately and as an integrated unit. Proposals shall properly reference previous work upon which their approach is founded.

- **Development approach:** Proposals shall describe the technical approach they intend to meet program metrics.

- **Technical risks:** Proposals shall identify technical risks and proposed mitigation strategies for each.

- **Team and Program Management and Internal Testing and Evaluation:** Proposals shall describe the approach to leveraging and managing the contributions of Offeror team members and their approach to testing and evaluation (T&E) of their developed systems independently from IARPA's T&E partner.

The following areas of research are out of scope for the SMART ePANTS program:

- Solutions that are only contained within rigid items of a garment. An example of such a system would include an AST built into buttons of a shirt alone with only a conductive connection between them.
- Solutions without strong theoretical and experimental foundations.
- Solutions without plausible scientific support for the proposed results.
- Development of individual components without a plan for integration into a complete garment-integrated system.
- Solutions employing commercial rigid interconnects for data export.
- Partial solutions that cannot be independently tested and evaluated against program metrics.
- Solutions that employ radioactive materials.
- Approaches that propose, or are likely to result in, only incremental improvements over the current state-of-the-art.
- Solutions that cannot be packaged for safety.
- Solutions that are incompatible with being worn in a garment.
- Solutions that are visually obvious, or that significantly disrupt the appearance or functionality of the garment.
- Solutions with significant limitations on operating conditions or operational parameters.
- Development of component technology that is not required for the Offeror's approach.
- Solutions that contain arsenic or other acutely toxic elements or compounds.
- Solutions that produce sound louder than 2 dBA in the audible range.
- Solutions that cannot be made sufficiently robust for field use.
- Solutions that cannot be reused as prescribed in Table 1.
- Solutions that rely on solar or kinetic energy for operation.
- Solutions that are integrated within outerwear clothing items such as belts, overcoats, jackets, scarves, gloves, shoes, or hats.
- Solutions that are integrated into non-clothing personal items such as jewelry (necklaces, badges, brooches, watches, earrings, rings, headbands, combs, or other hair arranging items), personal items (pens, notebooks, canes, eyeglasses, backpacks, fanny packs, hearing aids or other assistive devices that are not integrated into clothing) or grossly out of scale rigid clothing items (buttons exceeding 10 mm diameter, or decorative clothing items that are permanently attached to the garment such as sequins, decorative lighting, or non-washable embroidery).

1.D.   Modelling and Theory

Achieving program metrics will require Performers to develop experimental, analytical, or modeling evidence that their approach will result in a working prototype capable of achieving the performance, durability, and comfort metrics described in ==Section 1.F Program Metrics==. It is anticipated that Performers will have to advance the state-of-the-art in every component of their AST throughout the lifetime of the program, particularly in Phase 1. Therefore, in Phases 1 and 2, all Performers must provide a model to show how they intend to meet the metrics for the next program phase using the sensing system technology they have developed in prior phases.

1.E.   Program Performance Criteria, and Test and Evaluation (T&E) Methods

IARPA research programs include rigorous, objective evaluations aimed at demonstrating achievement of carefully designed technical performance metrics. This section describes the technical performance criteria for the program and gives an overview of how IARPA will measure program Performer success. Offerors shall use these criteria to explain how they will achieve successful research outcomes for the SMART ePANTS program. It is expected however, that T&E evaluation criteria will be refined or otherwise revised as the program progresses. Final criteria for Phase 1 of the program will be provided at program kickoff, with refinements to Phases 2 and 3 to be provided to all Performers on an as-needed basis.

At defined periods throughout the program, Performers will send five (5) test article ASTs to the IARPA T&E partner for independent evaluation, along with 5 control garments to be used for comparison purposes in durability and comfort evaluation. Independent T&E points are defined in ==Table 2==: Program Waypoint, Milestone, and Deliverables Testing Timeline, of this BAA.

1.E.1. Sensing Events

The SMART ePANTS program primary objective is to design garments capable of performing one or more of the following three sensing events listed below in order of increasing complexity, where Track 1 is the easiest and Track 3 poses the most difficult challenge to Offerors. Those who propose ASTs that respond to more than one Track with the same device will be viewed more favorably. Sensing events will all be measured indoors at regular intervals over the course of 8 hours within a temperature range of 0 – 40 ℃. Program research Tracks and Sensing Events are:

Track 1: Audio (Hear It)

The SMART ePANTS objective for Track 1 is to develop an integrated audio sensing system capable of recording up to 60 minutes of conversation between at least two individuals at ≥ 60 dB SBL pressure at the microphone/receiver (400-3200 Hz minimum frequency range). Recorded speech shall have a Speech Transmission Index (STI) of 0.6/1.0 or higher, using the International Electrotechnical Commission (IEC) Method 60268-16:2020: Objective rating of speech intelligibility by a speech transmission index.

Track 2: Video/Photography (See It)

The SMART ePANTS objective for Track 2 is to develop an integrated video sensing system (field of view shall be > 55 Degrees) capable of performing either or both of the following tasks:

a. Recording 360 monochromatic photographs, where photos including 12-point text can be read by commercial Optical Character Recognition (OCR) techniques at distances ≥ 50 cm under 200-500 Lumens (lm/m^2) illumination (380-740 nm wavelength) and can clearly reproduce the resolution of Group 2, Line 2 of a US Air Force 51 Optical Resolution Test Chart[3]; and/or

b. Recording a 2-minute monochromatic video under 500 lm/m^2 illumination (> 30 frames per second, 380-740 nm wavelength) and able to discern the resolution of Group 2, Line 2 of a US Air Force 51 Optical Resolution Test Chart.

<u>Track 3: Location (Locate It)</u>

The SMART ePANTS objective for Track 3 is to develop an integrated indoor geolocation system capable of providing relative latitude longitude readings every ten minutes for one hour with an uncertainty of no more than ±10 m at least 100 m away from a reference point of origin in three-dimensional space. Offerors should assume that the sensing system will be operating in a Global Navigation Satellite System (GNSS)-denied environment (e.g., in a building basement). Systems may employ images or signals from onboard cameras or antennas as a reference to aid in location determination if desired (such as office furniture, lighting, stationary signals of opportunity (e.g., Wi-Fi routers or computer Telecommunications Electronics Material Protected from Emanating Spurious Transmissions, TEMPEST, emissions) from inside a facility to help determine location, but those reference points will not be known prior to testing. If desired, the Offeror may request a system calibration be performed to establish a point of origin one hour prior to performing a sensing event.

1.E.2. Representative Sensing Event Scenario

Although no testing on humans is anticipated during the SMART ePANTS program, Offerors shall design their ASTs with the assumption that garments will need to perform sensing events under stresses and strains of a person's normal workday in an office or factory. Specifically, the garment must withstand the stresses of storage, donning and doffing the garment, moving around in an office or factory environment indoors, conferring with colleagues while sitting or standing, eating meals, storage in a crumpled state, followed by data offloading a week or more after data collection, and washing as illustrated in Figure 1. All sensing events may be assumed to occur in a well-lit indoor room with no windows. Offerors shall clearly describe any expected deviation from these stresses on their garments in their proposal.

---

[3] https://www.researchgate.net/figure/USAF-1951-optical-calibration-target fig1_230817663, accessed (March 8, 2022).
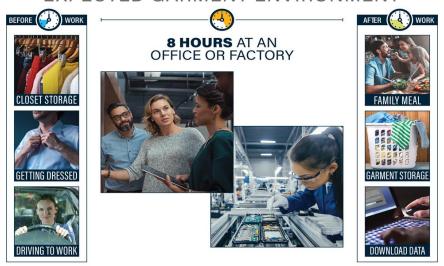
Figure 1: Expected conditions under which a SMART ePANTS AST might be stored and used.

1.E.3. Component properties

Offerors shall propose to develop fully integrated ASTs capable of performing one or more sensing events described in Section 1.E.1. Sensing Events, of this BAA. The overall goal of the SMART ePANTS program is to develop stretchable, bendable, washable AST that are fully integrated into clothing. Electronic components built into expected rigid items of a commercial garment are permissible although they should be kept to a minimum. Expected rigid items of a commercial garment may include grommets, zippers, buttons, collar stays and underwires. *Proposals to develop ASTs comprising a lower fraction of rigid components will be reviewed more favorably than those using more rigid components*.

Ideally, components, threads and yarns shall not exceed 0.6 mm diameter, with lower diameter threads viewed more favorably for proposal selection. Components that are ≥ 0.6 mm diameter within the garment are permitted but will be judged according to how much they detract from comfort/durability of the garment.

The proposal should clearly outline how all system components will be made flexible, stretchable, bendable, and waterproof by the end of the program. In keeping with the metrics in Table 1 in Section 1.F Program Metrics, all components must function as an integrated system, and must be reusable before and after the comfort and durability testing described in Section 1.E.3: Integrated System Comfort and Durability. Beyond the general component descriptions described in this paragraph, individual components must also possess the attributes described below. Offerors must provide a clear plan to develop a system that meets program metrics, but the value of individual components to the program will be weighted for proposal evaluation purposes. The component list below is described in order of increasing importance to the program.

1. *Sensors*: The selected sensor (camera, microphone, and/or geolocation sensor) shall have the ability to perform the Offeror-selected Sensing Events described in this BAA.

2. *Computation and Data Storage*: AST data processing and storage shall function seamlessly with other system components. Sensor systems shall have the capability to record and store data from a single sensing event that can be offloaded to another device at a later time. Data offloading procedures must be performable by a non-expert user by wired, wireless, or other means that shall be described in the Offeror's application. Offloaded data shall be readable by some external device, with documentation and procedures for data extraction provided to the government for all ASTs delivered.

3. *Power Source*: Power sources shall be matched to allow AST operation for an entire sensing event (as described in Section 1.E.1 Sensing Events) without reliance on an exterior power source for eight (8) hours. Power sources shall be rechargeable/refuellable as needed to perform sensing events before and after comfort and durability testing.

4. *Haptics*: User-evident actuation for on/off switches and any required operation (photo taking, position finding) must be easily performed by the wearer when fully clothed in an office or factory setting without disrobing, using external objects (such as magnets or styluses or other electronic devices), or reaching beyond a person's everyday range of motion.

5. *Interconnects*: Interconnects employed shall allow for operation of the AST while also meeting the comfort and durability metrics defined in Table 1.

1.E.4. Integrated System Durability and Comfort

In addition to testing for successful performance of the Sensing Events described in Section 1.E.1. and compliance with Component Descriptions in Section 1.E.2., Offeror ASTs will be tested for durability and comfort relative to an offeror-selected closely matching commercial reference garment. Comfort and durability for the SMART ePANTS program is defined by textile bend, stretch, compression, surface roughness, and breathability.[4] Offerors who propose integrated systems with a greater operating range of these comfort metrics (such as greater stretch or bend) are more desirable. A summary of the testing methods to be used is provided in this section.

Calendar life: ASTs will be tested for calendar life, where calendar life means the time between final preparation of the system for a sensing event, and the beginning of a successful sensing event test. For example, if a sensing system were battery powered, a calendar life of one week would mean that the garment was fully charged and placed in a clothes closet at room temperature (0 - 40 ℃) for one week before being removed for immediate testing with no other preparation.

Stretch, Bend, Compression, and Surface Friction and Roughness: Together, these four measurements will be made on AST deliverable test articles to evaluate garment comfort using reference[4] techniques.

---

[4] Apurba Das, R. Alagirusamy, "Chapter 4: Tactile aspects of clothing comfort, Section 4.3.2 Objective Assessment", Science in Clothing Comfort, 2010, Woodhead Publishing India PVT. LTD. pp. 54-78. https://doi.org/10.1533/9780857092830.54

Wash: Washing tests will be performed according to American Society for Testing and Materials (ASTM) 6330 or American Association of Textile Chemists and Colorists (AATCC) 61 test method wash cycles. Expected wash time is for 30 minutes followed by a 2-minute rinse (both at 20 ℃), and an 8-hour line dry at 30% RH indoors at 25 ℃. Washing will be performed in a <10 kg load with all five test garments for each T&E event together (whichever is lighter) in one top mount spindle washing machine. Washing will take place in either water or a dry-cleaning solvent (such as trichloroethylene), depending on the garment and request of the Performer, using a standardized detergent if necessary to be determined by the T&E partner at their sole discretion, and disclosed at the SMART ePANTS kickoff meeting.

Breathability: Each tested garment will be tested according to ASTM Method D737 for air permeability.

1.F.   Program Metrics

Achievement of metrics is a factor considered when determining whether to exercise options to continue performance under IARPA research contracts. IARPA has defined SMART ePANTS program metrics to evaluate effectiveness of the proposed solutions in achieving the stated program goal and objectives, and to determine whether satisfactory progress is being made to warrant continued funding of the Performers. The metrics described in this BAA are shared with the intent to scope the effort, while affording maximum flexibility, creativity, and innovation to Offerors proposing solutions to the stated problem. *All Offerors are expected to submit a research plan to meet the metrics described in this BAA. Proposals with a plan to exceed one or more program metrics will be evaluated more favorably.*

For purposes of this BAA, Offerors shall propose research that meets the technical metrics described in Section 1.E. Program Performance Criteria, and Test and Evaluation (T&E) Methods, and in Table 1. It is anticipated that specific T&E protocols including specific test equipment will be established at program Kick-off or shortly thereafter. Program metrics may be refined or further specified during the three phases of the SMART ePANTS program; if metrics change, revised metrics will be communicated in a timely manner to Performers.

This BAA puts forth definitions of expected AST performance, durability, and comfort, but there may exist other metrics that have not been contemplated by IARPA. It is acceptable for Offerors to propose alternative approaches, so long as such approaches are described in their proposal and are of a similarly challenging nature to those proposed in this BAA. Such alternate approaches will be evaluated in tandem with proposed techniques. In any case, SMART ePANTS will rely on the expertise of government and/or trusted agents (e.g., Federally Funded Research Development Centers, University Affiliated Research Centers) to independently measure the effective performance parameters as previously discussed, to refine measurement protocols as necessary, and to normalize textile and electronics testing regimes appropriately for a side-by-side comparison.

A summary of the metric targets by phase is shown in Table 1 and they are preliminary and subject to change over the course of the program.

Table 1: **SMART ePANTS Program Metrics and Related Targets by Phase**. Exact testing methods will be negotiated on a case-by-case basis for selected applications. Text in blue is an example of performance metrics required for a Performer AST versus a published reference textile,[5] and is listed only for illustration purposes.

Metric	Metric Target		
	Phase 1 (18 Months)	**Phase 2 (12 Months)**	**Phase 3 (18 Months)**
Integration	System components (See Section 1.E.3.) function separately and as an integrated system (See Section 1.E.4.)	Systems integrated into a primary garment (Defined in Section 1.A.1.)	Integrated garment meets all program metrics
Sensing Events	7 Sensing Events (three before, two during, and two after durability testing). Performance factors for Sensing Events are listed in Section 1.E.1. Exact durability tests to be performed during sensing events shall be mutually agreed upon after project selection		
Stretch **Example 3.5%**	<30 % below reference[6] (2.45%) x 5 repetitions	<20 % below reference (2.8%) x 10 repetitions	<10 % below reference (3.15%) x 50 repetitions
Bend **Example: 0.065×10^{-4} Nm/m**	<30 % above reference[6] (0.0845×10^{-4} Nm/m) x 5 repetitions	<20 % above reference (0.078×10^{-4} Nm/m) x 10 repetitions	<10 % above reference (0.0715×10^{-4} Nm/m) x 50 repetitions
Compression **Example: 0.21×10^{-4} Nm/m^2**		<20 % above reference (0.252×10^{-4} Nm/m^2) x 10 repetitions	<10 % above reference (0.231×10^{-4} Nm/m^2) x 50 repetitions

---

[5] Advanced Characterization and Testing of Textiles, The Textile Institute Book Series (2018), Pages 59-69 https://doi.org/10.1016/B978-0-08-100453-1.00004-0, E.Classen, Hohenstein Institute, Bönnigheim, Germany.

[6] For phase 1, integrated AST components shall be immobilized on a textile swatch that resembles the Performer-selected reference garment, tested using the metrics listed in this Table, and compared against the response of the Performer-selected reference garment (See Section 1.A.2. Program Phases).

Metric	Metric Target		
	Phase 1 (18 Months)	**Phase 2 (12 Months)**	**Phase 3 (18 Months)**
Surface Friction and Roughness		<20 % above reference Friction Coeff. 0.21±0.042 Rough Geom. 12.2±2.44	<20 % above reference Friction Coeff. 0.21±0.021 Rough Geom. 12.2±1.22
Wash	2 min. soak in solvent (water or dry-cleaning solvent) at 20 ℃, hang dry 24 hrs.[7]	30 min. wash in solvent (water or dry-cleaning solvent) at 20 ℃, 2 min rinse, hang dry 24 hours[7]	30 min. wash in solvent (water or dry-cleaning solvent) at 20 ℃, 2 min rinse, hang dry 24 hours
Breathability (Air Permeation)		<20 % reduction in air permeation versus reference garment	<10 % reduction in air permeation versus reference garment
Calendar Life	Can perform sensing event after 1 day of storage	Can perform sensing event after 1 week of storage	Can perform sensing event after 3 months of storage

1.G.   Program Waypoints, Milestones, and Deliverables

1.G.1. Waypoints

In addition to meeting the program metrics Table 1 at the times listed on Table 2, Offerors shall define interim "check-in" performance measurements called Waypoints which indicate technical progress of each task on the project. For example, Offeror AST Deliverables that are submitted on Month 15 of the program must meet the Metric requiring completion of seven Sensing Events as an integrated system. To show progress towards this Metric, an Offeror may propose Waypoints for each task, such as for their power source research indicating a forecasted energy capacity at Months 6, 9 and 12. Waypoints help the program management team to assess project progress and the need for any course correction during the program. At a minimum, each project task should have Waypoints every 3-6 months (depending on importance of the task). More frequent waypoints are encouraged for important project tasks.

1.G.2. Deliverables

A description of the program deliverables follows.

---

[7] Sensing systems will be wash tested in Phases 1 and 2, followed by a sensing event test for continued functionality for information purposes only. Failure to function after washing does not mean that the project will fail to advance to the next program phase.

AST Test Article Deliverables: Performers shall provide five (5) AST test article deliverables and five (5) reference primary garments with the same design and composition as the AST test articles. Testing event timing is described in Table 2: Program Waypoint, Milestone and Deliverables Testing TimeLine and shown in the program schedule in Table 2. Program Milestone, Deliverables and Testing Timeline. Performers shall also provide documentation to the Government proving the safe shipment of their test articles to the T&E site.

AST Development Plan Deliverables: Performers shall provide design documents and modeling and/or other calculations to demonstrate that their proposed system components can be expected to meet the program metrics for the Phase in which they are due. Models and/or other calculations shall support the Performer's ability to meet Phase 3 metrics by the end of the program.

Technical Reporting: Performers shall provide monthly technical reports no later than 10 days after the first of each month. These reports shall detail technical progress made towards waypoints and milestones completion, major risks, planned activities, trip summaries, changes to key personnel, and any potential issues or problem areas that require the attention of SMART ePANTS Program Management. Both the results presented at technical review meetings and technical reports will serve as an official record of progress. Technical reports shall include the results of internal performance tests as follows. Performers are expected to evaluate their ASTs continually throughout the program to measure progress toward achieving program metrics. Internal performance testing shall be a subset of the test protocols for performance in Section 1.E.1. Sensing Events, and for durability and comfort as described in Section 1.E.4. Integrated System Durability and Comfort. The results of internal performance testing shall be included in the Monthly Technical Reports, as internal performance testing is completed, no less frequently than every six months throughout program performance. The first Monthly Technical Report shall contain a description of the Performer's testing methodology for internal performance testing. The Performer and the PM shall agree on the Performer's testing methodology not later than the 3rd month after program kickoff, with the first internal testing to be completed not later than the 6th month of the program.

Technical Review Meetings: Performers shall support monthly technical review meetings in person at the Performer's site (see Site Visits below) or remotely (e.g., by means of telephone, Skype, WebEx, Microsoft TEAMS, video conference or similar, at the discretion of the PM). During these monthly technical review meetings, Performers will present their results, describe their progress toward waypoints and achievement of performance metrics, identify any issues that may affect their ability to meet metrics, milestones, or overall program objectives and describe a risk mitigation plan as required.

Site Visits: SMART ePANTS program management team and invited representatives of Government agencies will visit each Performer at their work site to conduct an in-depth review of progress toward program objectives and to meet with team members. Performers shall host these site visits at the sites where research for the SMART ePANTS program is being performed. During site visits, Performers will show their physical capabilities, and introduce the researchers working on the program to the program management team and invited Government representatives. The site visit shall be concurrent with the technical review meeting to be held in the same month.

Kickoff and Program Wide Review Meetings: Kickoff and program wide review meetings shall be held at a location to be determined by the PM, typically in the Washington, D.C. metropolitan area, where Performers shall share non-proprietary information and/or updates with the other Performers. Typically, program-wide review meetings, also known as Principal Investigator (PI) Meetings, will also include breakout sessions for each team to meet individually with the PM, the program management team, and the T&E team. At these breakout sessions, any results the Performers assert are proprietary shall be discussed. Performers shall plan to send no more than 2-3 key technical personal to the program wide review meetings, unless otherwise agreed with the PM. Unless otherwise specified in the program schedule or by the PM, kickoff and program wide review meetings are in addition to the monthly technical review meetings.

Financial Reporting: Performers shall provide monthly status reports (MSRs) not later than ten days after the first of each month. The MSRs shall summarize budget and spending and identify any financial issues that may affect the program or put achievement of program objectives at risk.

1.G.3. Program Milestone and Deliverables Timeline and Deliverables

Table 2 shows a timeline for the program with Government-defined milestones and deliverables.

Table 2: Program Waypoint, Milestone and Deliverables Testing Timeline

Event	Months after Kick-off			Deliverables
	Phase I	**Phase II**	**Phase III**	
Kickoff Meeting (Beginning of each Phase)	1	19	31	Read-ahead package due from Performers to the Government 7 days before meeting. If required by the PM, updates after the meeting are due 15 days after the meeting date.
Program Wide Review Meeting	16	28	42	Read-ahead package due from Performers to the Government 7 days before meeting. If required by the PM, updates after the meeting are due 15 days after the meeting date.

Event	Months after Kick-off			Deliverables
	Phase I	**Phase II**	**Phase III**	
Technical Review Meetings	Monthly	Monthly	Monthly	Read-ahead package due from Performer to the Government 2 days before meeting. If required by the PM, updates after the meeting are due 15 days after the meeting date.
Site Visits and Waypoint Review	3, 9, 15	21, 27	34, 40	Site visits (to be held concurrently with Technical Review Meetings)
AST Test Article Deliverables	15	27	41	Test Articles delivered by Performer for T&E. Deliverable shall be received at the T&E site specified by the Government no later than the final day of the listed month. Performers shall also provide documentation and training to the Government for proper usage of the AST. Documentation proving the safe shipment of deliverables to the T&E site is also required.
AST Development Plan Deliverable	17	29	41	Plan describing deliverables for the next program

Event	Months after Kick-off			Deliverables
	Phase I	**Phase II**	**Phase III**	
				phase is delivered to the government. Deliverable shall be received by the Government no later than the final day of the listed month.
Independent T&E	15-16	27-28	41-42	Upon receipt of the Performer Test Article Deliverables, T&E will be conducted. Performers may expect test results within two months of test article submission, but no later than the last day of the listed range of months.
Financial and Technical Reports	Monthly	Monthly	Monthly	Monthly financial and technical reports are due by the 10th day of the following month.
End of Phase	18	30	42	Phase Period of Performance Ends

In addition to scheduled deliverables shown in Table 2, the Government anticipates receiving the following as deliverables throughout the program (note that this list is not inclusive and is provided here as guidance for the Offerors). The award instrument type may alter this list.

- Any technical papers covering work funded by SMART ePANTS;

- A final report for each program phase that concisely describes and summarizes the work conducted, technical achievements, and remaining technical challenges, shall be due one calendar month after the end of each phase: and

- A final summary report shall be due at the end of the overall period of performance.

1.H.   Meeting and Travel Requirements

Offerors are expected to assume responsibility for administration of their projects and to comply with contractual and program requirements for reporting, attendance at program workshops, and availability for site visits. In-person events will be held as allowed by US government health recommendations and IARPA policy. The following paragraphs describe typical expectations for meetings and travel for IARPA programs as well as the contemplated frequency and locations of such meetings. In addition to ensuring that all necessary details of developed designs, approaches, and test articles are on track, each Performer will be required to be available to answer technical and programmatic questions from each T&E team in monthly status meetings.

1.H.1. Kickoff and Program Wide Review Meetings

The SMART ePANTS program intends to hold a program kick-off meeting in the first month of the program and Program Wide Review Meetings on a regular basis throughout the program. The dates and locations of these meetings are to be specified at a later date, but for planning purposes, Offerors should use the approximate dates and locations listed in Table 2. These meetings will typically be of a two-day duration, will be held in the Washington, D.C. metropolitan area (or an alternate location in the United States at the discretion of the PM), and will focus on technical aspects of the program and on facilitating open technical exchanges, interaction, and sharing among the various program participants.

During all such meetings, program participants will be expected to present the non-proprietary technical status and progress of their projects to other participants and invited guests. Individual sessions for each Performer with the Government Team will also be scheduled to coincide with these workshops. Typically, meetings will also include breakout sessions for each team to meet individually with the PM, the program management team and the T&E team. At these breakout sessions, any results the Performers assert are proprietary shall be discussed. Performers shall plan to send no more than 2-3 key technical personal to the program wide review meetings, unless otherwise agreed with the PM. Unless otherwise specified in the program schedule or by the PM, kickoff and program wide review meetings are in addition to the monthly technical review meetings.

1.H.2. Site Visits

Site visits by the Government Team including T&E partners and selected non-government advisors will generally take place according to the schedule in Table 2 but may increase to four times a year (at the discretion of the PM) during the life of the program. These visits will occur at the Performer's facility (either the prime or any subcontracted Performer). In addition to traditional means of conveying information such as reports and briefs on technical progress, details of successes and issues, and contributions to the program goals, Performers will be required to provide live, and interactive technology demonstrations, as appropriate.

1.H.3. Technical Status Meetings

The PM will be in frequent communication, in person or by teleconference, with Performers including both Prime and Subcontractors. Offerors should plan for monthly teleconference calls of one hour in duration with their technical staff present to answer questions regarding the state of their research. The frequency of these calls may change at the discretion of the IARPA PM.

1.I.   Place of Performance

Performance will be conducted at the Performers' sites, except for the tests at the end of each phase, which will occur at IARPA established testing sites.

1.J.   Period of Performance

The SMART ePANTS program is envisioned as a 42-month effort that is intended to begin January 2023. Phase I – Base Period of the program will last 18 months; Phase II – Option Period 1 will last 12 months; and Phase III – Option Period 2 will last 12 months.