America's Flexible Hybrid Electronics Manufacturing Institute

PROJECT CALL 4.0

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SECTION 1. FHE DEFINITION

This section is provided as an introduction to potential members of NextFlex® ("Institute" or "the Institute") who may not be familiar with Flexible Hybrid Electronics (FHE) and the scope of our efforts in the Manufacturing USA network. NextFlex describes FHE as the intersection of additive circuitry, passive devices, and sensor systems that may be manufactured using printing methods (sometimes referred to as printed electronics) and thin flexible silicon chips or multichip interposer structures. These devices take advantage of the power of silicon and the economies and unique capabilities of printed circuitry to form a new class of devices for IoT, medical, robotics, consumer and communication markets. FHE devices conform to any shape, but are also bendable, twistable, and stretchable. While NextFlex primarily uses the term "flexible," the Institute is interested in manufacturing methods that fall into the categories of flexible, stretchable, conformable, and direct-deposited circuitry (circuitry applied directly to a 3D surface without the need for a substrate or carrier). In light of this, the Institute will focus its efforts on solutions that combine silicon and flexible, stretchable, or conformable systems with a significant component of additive processing as part of the design. Proposals and approaches that target pure "printed systems" and additive processing of organic transistors or other logic systems (metal oxide, carbon nanotubes) as their primary focus will most likely be considered at too low of a Technology Readiness Level (TRL) for Institute Project Calls as of 2018. Conversely, approaches that appear to be incremental advancements on currently mature manufacturing technologies will potentially be considered at too high a TRL/MRL level to be considered for Institute funding (such as a traditional printed flexible circuit board approach utilizing solely etched copper for conductors and COTS packaged die for the active components at the system level and solder reflow assembly). More details on MRL and TRL can be found at http://esto.nasa.gov/files/TRL_definitions.pdf and http://www.dodmrl.com/.

SECTION 2. INTRODUCTION AND BACKGROUND

NextFlex is an industry-led, dynamic, collaboration-based institute formed to facilitate technology innovation and commercialization, accelerate manufacturing workforce development, and promote sustainable ecosystems for advanced manufacturing. One mechanism to enable technology adoption is to provide cash awards to proposal teams undertaking development projects that are critical to FHE manufacturing. In these cases, the Institute may provide cash awards for up to 50 percent of the development cost of the project through a structured selection process. Projects submitted to NextFlex for funding should consider the value to the Institute and the FHE industry as well as the future goals of advancing the FHE ecosystem within the US, and clearly articulate those aspects to the Institute in the proposal process. In addition, all projects should define a commercialization or technology transition plan that demonstrates industry pull for the proposed manufacturing technology development.

Project Call 4.0 (PC 4.0) will address project focus areas as identified in the FHE Roadmap developed by the NextFlex Technical Working Groups (TWG) through partnership between industry, government, and university subject matter experts, and reviewed by the Technical and Governing Councils of the Institute. PC 4.0 will address two approaches: Manufacturing Thrust Area (MTA) and Technology Platform Demonstrator (TPD). Project proposals are expected to be industry-driven problems, with proposed solutions and a concept to transition to the US industrial manufacturing base. PC 4.0 is anticipated to fund up to approximately $5.5M, resulting in multiple awards in one or more topics depending on the quantity and quality of proposal submissions received. Including cost-share, the total project value is expected to exceed $11M. The number of awards per topic will be based on the quality of the proposals, the funding requests of those proposals, and alignment with the overall roadmap and charter of the Institute.

NextFlex has experienced an increasingly focused Project Call process, building upon developments from preceding project calls. PC 1.0 focused largely on FHE application areas in the two largest markets: human health monitoring and structural asset monitoring. PC 2.0 had the benefit of the NextFlex roadmap activity and the gaps resulting from that to work from. As a result, several equipment development efforts were launched to create tools tailored for FHE production. In PC 3.0, the focus turned to two areas: subsystem development and manufacturing process or capability gaps. For PC 4.0, the focus is circling back and identifying gap areas for which the MRL lags the other aspects of an FHE system. While there is a strong focus on the manufacturing needs for components, subsystems, reference designs, and process

infrastructure, there are also three demonstrator areas in PC 4.0 that seek to integrate some of the advancements from previous calls into unique application area demonstrations in asset monitoring, unmanned aerial vehicles (UAVs), and chemical monitoring of people.

TPD topics will focus on developing subsystems and demonstrations of applications while MTA topics will focus on developing processes, critical components, or software tools, and efforts in both categories should consider that they will be expected to generate data for the NextFlex Materials and Process Database as well as generate data that can be used in design and modelling including the use of the NextFlex FHE process design kit (PDK). In addition, TPD projects will be required to produce a sufficient quantity of demonstrators/prototypes that will ensure that scalable manufacturing techniques are used in the production thereof.

Important notes:

- Based on the project scope defined with the help of the NextFlex Technical Working Group co-leads, NextFlex anticipates funding one project for each TPD topic and up to two projects for each MTA topic. However, other outcomes are possible depending on the cost and quality of the projects proposed.
- Given the clear focus on projects that have a near-term commercial application, teams that are industry-led or have a strong industry partner as part of the commercialization plan will be favorably considered in the evaluation process.
- Prior to final granting of awards, recipients and their partners who are not already NextFlex members will be required to become members of the Institute and execute a development agreement.
- Should teams find that the topics listed herein are not of interest to their organizations, NextFlex anticipates announcing Project Call 5.0 in calendar year 2019, and topic recommendations should be brought to the attention of the NextFlex Technical Working Groups.

NextFlex Technology Hub and Pilot Line: NextFlex members have collaborated to create a shared FHE back-end integration facility for prototyping and low volume manufacturing in a class 10,000 cleanroom. This facility, the “NextFlex Technology Hub,” includes both standard EMS and printing tools as well as custom FHE manufacturing tools developed through prior Project Calls. Capabilities are intended to provide a transition from development to production manufacturing for Institute members. The Technology Hub is an ideal platform to integrate and collaborate across projects thereby strengthening long-term capabilities for the FHE community. Proposal teams are encouraged, when possible, to:

1) Leverage the FHE manufacturing and testing capabilities in the NextFlex Technology Hub during the execution of the project, and
2) Demonstrate newly developed FHE manufacturing processes on the Technology Hub tools. This facility may also be appropriate for TPD projects. Proposal teams may receive more information about the Technology Hub by contacting proposal@nextflex.us.

Manufacturing USA – A New Way of Doing Things: Submitters with experience in government funding should take special note that the ways in which NextFlex and Manufacturing USA Institutes operate may be quite different than what proposers may be accustomed to. For small businesses, the NextFlex development projects should not be compared to SBIR, STTR, NIH, or other similar programs. The objective is not to develop a specific product, but rather to solve a common gap that many companies in the space are facing. Research institutions familiar with NIH or NSF funding should be aware that NextFlex projects are designed around time-bound and measurable deliverables with clear performance metrics. If these cannot be established at the outset of the project, the subject matter under consideration may be of too low an MRL and thus more suitable for an NSF-type proposal. For those accustomed to government acquisitions, these programs are aimed at co-funded development; thus, a cost share element is required. Additionally, the project reimbursements will follow a cost reimbursable-type agreement with an approved overhead rates methodology. Commercial rates or profit (fee) are not suitable for funded project submissions.

Project Scale and Duration: The federal funding available on a per project, per topic basis is indicated in each topic description section. These numbers were developed by the Technical Working Group co-leads based on anticipated scope and resources required to deliver the requested statement of work. The duration of proposed Institute projects is typically 12 to 18 months. Projects should not exceed 24 months for any single phase and aggressive timelines are encouraged.

It is critical to underscore that NextFlex project must meet a minimum MRL of 3 to 4 in the foundational work that projects are built upon. In consideration of this, proposing team must either provide physical samples to NextFlex of the foundational work that will be built upon or provide published references that indicate the minimum MRL has been met by prior work. Samples may be sent to NextFlex at:

Attn: Program Management
NextFlex
2244 Blach Place, Suite 150
San Jose, CA 95131

Tracking information for any parcels may be sent to: proposal@nextflex.us.

Please clearly mark any samples indicating the proposal to which it pertains as well as any relevant confidentiality notices and please provide a return post address and contact details for the submitter in the package with the sample.

Cross-Institute Collaboration: As of 2018, more than 14 Manufacturing USA Institutes exist in various technology areas. Proposals which enable collaboration between Institute programs and have access to funding from more than one Institute should be identified by the proposers for the consideration of the reviewer base, as collaboration across technology fields with strong market demand is always encouraged. NextFlex is also willing to entertain proposals that bring in co-investment from other sources including other government agencies, commercial sponsors, state governments and where appropriate, other type of research entities.

SECTION 3. FHE ROADMAP 3.0

The Institute leverages the electronics industry and the high-performance printing industry, both well-established US industrial and academic areas of strength. A comprehensive roadmap was developed in collaboration with industrial partners, academics, and subject matter experts (SMEs) in a variety of fields. The roadmap topics include different facets of application-specific devices/components for technology demonstration as well as various aspects covering design, materials, process, equipment, and test development that would enable realizing advanced manufacturing capabilities to meet the overall vision of the Institute and the FHE eco-system. The following topics are the focus of the Technical Working Groups that developed the roadmap:

- Manufacturing Thrust Area
  - Device Integration and Packaging
  - Flexible Power
  - Materials
  - Modeling and Design
  - Printed Flexible Components and Microfluidics
  - Standards, Test, and Reliability
- Technology Platform Demonstrators
  - Asset Monitoring Systems
  - Human Health Monitoring Systems
  - Integrated Array Antenna Systems
  - Soft and Wearable Robotics

Since technology adoption through enabling manufacturing readiness is the primary mission of the Institute, only proposals in the TRL 4 to 7 and MRL 4 to 7 range will be supported for funding. Based on the gaps

identified through the TWG road-mapping process and reviewed by the NextFlex Technical and Governing Councils, proposals in the following specific areas are prioritized and will be considered for potential funding in PC 4.0.

SECTION 4. PROJECT CALL TOPICS

In PC 4.0, there are nine Project Call topics, which are divided among two categories: (1) Manufacturing Thrust Area and (2) Technology Platform Demonstrators. As the NextFlex community and the FHE manufacturing matures, there are opportunities to combine NextFlex development investments with other government agencies or commercial interests. To that end, proposals that include external DOD agency funding for technology solutions to specific DOD requirements or direct funding from a separate commercial business unit will be prioritized. Additional DOD agency funding can be executed through the NextFlex cooperative agreement or a separate agreement or contract.

4.1 Manufacturing Thrust Area (MTA)

The objectives of this topic area are to focus on developing and qualifying manufacturing processes, methods, or tools identified as FHE needs via the roadmapping process and discussions with TWG leads and members. The processes and the tools developed will have a considerable impact on the manufacture of low-cost reliable systems for a wide range of defense and commercial applications.

Any development of software tools should include licenses or provisions to allow NextFlex members and Institute personnel to access and use the tools for development purposes, and it is expected that third-party licensing needs or maintenance costs required to operate the tools will be considered by the proposal team and addressed as part of the proposal.

In the case of projects focused on process development, it is expected that those process developments will be documented in a level of sufficient detail that it is reliably replicable and that it may be included in manufacturing guidelines for relevant processes in the future. Processes or approaches developed under NextFlex Project call funding must provide unencumbered use licenses for their implementation on the NextFlex Technology Hub to continue the advancement of the NextFlex FHE ecosystem.

More specifically, **MTA topics shall include, but are not limited to, the following deliverables:**

1. NextFlex Materials and Process Database inputs at the quarterly reporting intervals following the acquisition of the data.
2. A flow chart of the process steps and design information (such as drawings, CAD files, etc.) for device fabrication or process repetition.
3. Relevant process information including:
    a. Resolution, thickness and material properties (e.g., sheet resistance) that can be obtained with the developed recipe
    b. Tolerance and yield of components, along with a comparison to device manufacturing processes that are currently used in the industry
    c. Consistency of print quality (line edge raggedness, loss or gain in dimension, uniformity in thickness and layer roughness) of the layer(s) in the device
    d. Consistency in device properties (resistance, capacitance, inductance, etc.) along with a comparison to similar devices that are commercially available
    e. Optimized print equipment parameters (print speed, ink volumes, ink viscosity, curing conditions, print environment, etc.)
    f. Mechanical constraints (e.g., tensile strength, bending) of the printed devices
4. Details of the method of test and measurement performed during development to establish TRL and MRL advancements.
5. Identification of the specific task and outcome that results in TRL and/or MRL advancements.
6. Cost model framework and associated assumptions for the proposed manufacturing technique.

The following section outlines the process development topics in the MTA area for PC 4.0.

PC Topic MTA 4.1: FHE Device Encapsulation and Overmold

$400,000 maximum government funds / Up to a 12-month duration

Many FHE devices will require encapsulation to protect them from damage in handling and the use environment. In addition, once protected the devices will often require methods to attach them to other objects, which is many cases if inextricably linked to the encapsulation approach. This topic seeks encapsulation or overmold solutions and adhesive attachment methods for FHE devices that will allow the devices to be attached to commercial or industrial assets for a wide range of use cases. Approaches must ensure the mechanical protection, water ingress protection, and dust or contamination proofing of the device for the outlined use cases. Proposers must identify an application or use case and the associated requirements including:

- Permanent or removable attachment
- Maintenance or replacement life cycle
- Materials which the device (e.g., Si die, passives, sensors) may integrate encapsulate
- Materials attached to may include encapsulation of die bond pads for migration
- Curvature of the installation surface
- Flexure requirements during the use case
- Device size (plan area and thickness, unencapsulated and encapsulated)
- Electrical connections outside the encapsulation, e.g., to replaceable power sources or sensors or programming terminals
- Sensor or battery change allowances
- Battery charging
- Communication

Proposed encapsulation and attachment methods should be applicable to many FHE devices. Proposals to develop multiple solutions will be entertained. Modular solutions that enable battery or sensor changes and FHE-to-FHE device connections will be given preference.

Funding under this topic will not include the design/development of the FHE devices to be encapsulated; projects should use FHE devices previously developed under NextFlex or other funding. Proposers may provide the devices (reasonable costs to build or procure the devices can be included in the budget) or base their designs on FHE devices that will be provided by NextFlex; proposers interested in this option should coordinate with NextFlex while developing their proposal and throughout project execution to account for device capabilities and requirements.

Deliverables for this project must include complete process and material specifications, design files associated with the specific solution, 25 encapsulated devices, and five unencapsulated devices (if using devices provided by the performer). The encapsulation materials availability must be specified (pilot-scale development materials to commercial products are expected). Novel approaches requiring specialized tools may include an option to extend funding to provide such a device to NextFlex in San Jose for institute member use and evaluation.

PC Topic MTA 4.2: Advanced 3D Electrical Design Software Solution

$400,000 maximum government funds / Up to an 18-month duration

Improvements in fabrication techniques for flexible electronics—such as precision “pick & place” and multi-axis additive manufacturing tools—have significantly opened the design space to devices with complex and irregular geometries. However, current electrical design tools for micro-circuitry layout are predominantly based on 2D and layered design approaches. 3D visualizations of the device layout are becoming increasingly more available as component makers provide CAD

models for design tool integration, but design edits in the 3D environment are still limited. To address these issues, the project call seeks innovative concepts for 3D-design user environments for the layout of FHE devices. Improvements in live 3D editing, efficient handling for FHE component CAD model libraries, and robust layout algorithms for design on arbitrarily complex surfaces and volumes are encouraged. The development of design constraints based on specific additive manufacturing techniques, curvature criteria, and/or other process-related limitation are also relevant for this topic area. Responses to this area must include compatibility with the NextFlex PC 2.0 open-source PDK or a near term path to ensure compatibility as well as any related or complementary electrical design tool, modeling or simulation development efforts underway. The project must deliver usable tools to NextFlex inclusive of any 1st or 3rd party licenses, and those tools must also be made available at a reasonable cost to any NextFlex member in good standing.

PC Topic MTA 4.3: Evaluation and Development of Connectors for FHE Devices and E-Textiles

$250,000 maximum government funds / Up to 18-month duration

This topic seeks evaluation and development of available methods for joining either permanently or temporarily, subsystems within FHE devices. Approaches may focus on flexible devices, devices integrated with stretchable and textile substrates, or both. Demonstrators may include integration pathways for optical components, biochemical sensors, electrical connections, or other comparable components. Deliverables for the project must include key data and evaluations related to established use cases as well as prototypes, test vehicles or reference designs, and supply sources for the key components. Connectors must be able to be connected and—if appropriate—disconnected by hand or with simple manual tools in the field and have their functionality be demonstrated within the established use case. Proposed projects with specific DOD customer applications or near-term consumer markets will be prioritized. Proposed program to develop connectors from cables to traditional electronic systems are not within scope of the project call topic (for example: connector development from twisted wire cables to soldier radios). It is expected that temporary connectors will be capable of a minimum of 100 connect and disconnect cycles and any portions that remain attached to a textile must survive at least 50 wash cycles in 60°C. The connectors must have at least one method to interface with printed conductors and mechanical robustness at that junction as well as anticipated effects related to silver migration, galvanic reactions and corrosion must be hypothesized and tested as part of the project.

PC Topic MTA 4.4: Development of a Carrier System Appropriate for Sheet-to-Sheet FHE Manufacturing

$250,000 maximum government funds / Up to a 9-month duration

Develop a working system which can hold flexible and/or stretchable thin substrates throughout processing (inclusive of printing, component placement, and encapsulation steps as well as in-process metrology) where the flexible substrate can be attached and removed through an envision automation process, with the performance comparable to that seen in rigid panel processing. The proposed program must address the bond and release stress to include scalable-to-commercial size substrates used in electronic assembly (i.e., up to 18” × 24”). The scale-to-commercial substrate sizes must consider the total weight of the carrier as applicable to robotic handling used in commercial assembly tooling. The substrate carrier solution must enable processing to include multiple printing steps, die and component attach, several thermal cycles for curing and sintering (150 °C to 250 °C required), and combinations of quality assurance and final test. The method and materials must keep the substrate in a very flat condition at a level suitable for bare die flip chip bonding (maximum deviation under any single bare die component must be 1 µm or less). The optimal approach should be cost effective (and reusable), and cost analyses should be inclusive of any manufacturing costs or licensing fees for background IP. In addition, the preferred solution

would allow for good to moderate thermal transfer from a heated platen or chuck that the carrier and substrate are placed on for processing. It should not be assumed that the platen or chuck has any specific capability such as vacuum holding. Any development proposed must reference relevant industry standards or prior art and ensure that it is addressing known challenges in fixturing sheet based flexible substrates. Deliverables for this project must include complete process and material specifications, as well as CAD models and construction drawings, 20 working carrier systems with a minimum size of 200 mm × 300 mm and preference will be given to approaches that enable double-sided assembly and integration. The double-sided assembly is a critical distinction from commercial flexible display bond-and-release manufacturing processes. Removal of processed substrates are to be demonstrated without damaging printed structures or components placed.

PC Topic MTA 4.5: High Layer Count FHE Processing with IC Interface Demonstration

$700,000 maximum government funds / Up to an 18-month duration

Proposals in this topic will demonstrate high-density FHE designs that provide a compatible alternative for traditional methods of electronic manufacturing such as PCB plate and etch approaches. Consequently, proposals in this area should seek to advance the leading edge of high layer count—i.e., eight layers or greater in at least one section of the design—and interconnectivity with either bare die or conventional packaged electronics. Any demonstration should be centered on a specific application that requires or benefits from multiple internal conductive layers and include interconnects to chipsets and SMT components using inks, paste, and solder materials. Interconnects demonstrated during this project should be tested for both electrical and mechanical faults. This must include integration of components and evaluation of systems function as well as thermal management. Critical factors that successful proposals must address include: registration and alignment, interconnect viability, and bend survivability between bare die or packaged ICs over a single axis bend of 50 mm radius in areas between the components. Project results should determine the optimal combination of materials and process steps to achieve the end prototype product and deliver 25 working devices complete with materials data, fabrication process documentation and flow, test methods used and a summary of all results the test results. Proposals should deliver an estimated cost and process time comparison compared to conventional processing. Proposals must clearly identify a calculated conductivity requirement for the interconnects and traces to ensure IR drop does not compromise system functionality under the operating temperature range of -40°C to +85°C and establish feasibility based upon prior work. All materials and process data used and characterized in the project must be uploaded or input to the NextFlex Materials and Process Database.

PC Topic MTA 4.6: Flexible Battery Integration Demonstration and Reference Designs

$400,000 maximum government funds / Up to a 12-month duration

Projects in this topic area will produce for the NextFlex community reference designs for battery, energy storage, or power sources integration into FHE devices. Proposals must include two elements:

- A paper study comparing battery chemistries, cell designs, and the systems required to support their use. The study shall include both primary and secondary batteries. Comparisons must include at least electrical performance characteristics (e.g., power density, energy density, cell voltage, internal resistance), mechanical properties (flexibility, bend radius), power management circuit elements, and commercially available cell configurations. The study should be presented in a form that facilitates selection by designers. Any baseline efforts should leverage prior work including development work done under SEMI or FlexTech programs.

- Development and testing of two reference designs for FHE integration—one based on rechargeable cells and one based on primary cells. Analysis of alternatives in the design process should be presented. Each reference design must include cell selection, power management circuit, manufacturing strategy—including interconnect methodology and encapsulation / final packaging—as well as a proposed method to integrate with an FHE device (e.g., lamination strategy and method to make electrical connections before or after encapsulation). The reference designs must be fabricated and tested to provide performance characteristics, mechanical properties, and initial reliability data, including of charge and discharge testing. Nominal specifications for the reference designs will include:
    - Minimum capacity 400 mAh (or 120 mAh with a footprint constraint of less than 1.6 cm^2)
    - 3.7 V supply
    - Average bend radius requirement 3 cm; flat segments up to 1 cm
    - Thickness of less than 2.3 mm

The generated reference designs must be made available to NextFlex and its members with unencumbered rights for their use.

4.2 Technology Platform Demonstrator (TPD)

The flexible hybrid electronics TPDs are used to highlight technology capabilities based on FHE manufacturing processes. The technology platform projects are not intended to result in product development, but rather are an opportunity to showcase FHE capability and manufacturing technologies broadly with the intention of encouraging designers and OEMs to incorporate these technologies into their future products. TPD programs are encouraged to demonstrate FHE manufacturing relevance to funded DOD programs of record and/or commercial product opportunity. In addition to highlighting technology capability, TPDs will also facilitate the identification of critical and pervasive manufacturing gaps to productize the demonstrated technology. The proposals should fall within TRL 4 to TRL 7 range. TPD projects should produce a minimum set of functional prototypes as outlined in the topic descriptions and deliver them to NextFlex in San Jose, California, for testing and demonstration purposes. Please note that quantities of delivered prototypes have been identified to ensure scalable manufacturing techniques are used in the production of the demonstrators. In PC 4.0 it is the intent of the TWGs that these demonstrators will provide a common subsystem approach that will allow subsequent projects or teams to rapidly develop application-based demonstrators, which while not optimized for performance, will greatly accelerate the speed of proving concepts for prospective applications. In addition to the prototypes, TPD projects will provide the following deliverables:

1. Prototype Specifications including:
    a. Description of the capability provided by the TPD or manufacturing process.
    b. Expected size, weight, and volume of the TPD.
    c. Expected operating environment and range that will be evaluated during the effort.
    d. The approach to powering the TPD and methods for recharge or battery replacement, if appropriate.
    e. Data acquisition approach and communication protocols, if appropriate.
2. NextFlex Materials and Process Database inputs at the quarterly input following the acquisition of the data.
3. A flow chart of the process steps and design information (such as drawings, CAD files, etc.) for device fabrication or process repetition for R&D purposes. This information will include, but not be limited to: schematics, component bill of materials, netlist, layouts, print files, materials used, manufacturing methods, tools, and process information as well as programming information and any source code or assembly language code and information on compatible compilers and boot loaders for the microcontroller (if applicable).
4. Details of the method of test and measurement performed during development to establish TRL and MRL advancements.
5. Identification of the specific task and outcome that results in TRL and/or MRL advancements.

6. Twenty-five (25) functioning devices (unless otherwise specified in the topic area), demonstrators, or prototypes delivered to NextFlex

The following TPDs have been identified as focus areas for PC 4.0:

PC Topic TPD 4.7: Large-Area Sensor System for Structural Health Monitoring

$800,000 maximum government funds / Up to an 18-month duration

Large-area sensor systems for structural health monitoring have numerous applications. This topic seeks proposals to develop a large-area sensor system that can monitor a surface or volume that is at least three-square feet surface area. The sensor system should be flexible and able to conform to surfaces or wrap around edges of structures/volumes. Sensor systems should monitor strain, impact, temperature, or other parameters as defined by the project responder. Also of interest are systems that include the capabilities to sense and respond via actuation. Each project responder shall clearly define the target application and the merits of the sensor system in that application, as well as analogous applications which would also benefit from such a platform. Sensor systems that are applied early in product life cycles and remain useful through production processes and into the usage life of the product are of high interest. Methods of attachment of the sensor system shall be clearly defined. Sensor systems that can provide the location of a particular measurement, or group of measurements, are of high interest. Proposals that include external DOD agency funding for technology solutions to specific DOD requirements or direct funding from a separate commercial business unit will be prioritized. The requirement for additional DOD agency funding can be executed through the NextFlex cooperative agreement or a separate agreement or contract. This prioritization should demonstrate the broad relevance of the proposed TPD outside of the proposing organization.

PC Topic TPD 4.8: Minimally Invasive Wearable Flexible Devices for Monitoring of Fluid-Based Biomarkers

$1,000,000 maximum government funds / Up to an 18-month duration

There are numerous wearable physiological sensors available in the market for monitoring of parameters such as heart rate, temperature, blood oxygen level, etc. In contrast, there is a limited number of wearable biomarker sensors for continuous and non-invasive monitoring of biochemical parameters, such as electrolytes, metabolites, proteins, blood gases, etc. This is due in part to significant device integration challenges. NextFlex has devoted significant resources toward development of low-cost wearable saliva and sweat sensors that are particularly suited for measurement of some metabolites and electrolytes under moderate-to-high-exertion activities. Minimally invasive and frequent analysis of fluid-based biomarkers are highly desired in applications ranging from diabetes management to infectious disease diagnosis and management to fatigue and stress monitoring.

In this topic area, proposals for development of non-invasive or minimally invasive fluid collection solutions integrated with on-demand to continuous biochemical marker sensing modalities in user-friendly wearable formats that support the “wear-and-forget function” for at least 24 hours are requested.

Biomarkers of interest include metabolites (e.g., lactate or glucose), small molecules (e.g., cortisol and Orexin-A), and proteins (e.g., inflammatory biomarkers such as cytokines) which can be extracted from biofluids such as interstitial fluid, lacrimal (tear) fluid, sweat, or saliva. Proposers should choose a specific biomarker (or biomarker panel) and provide clear clinically-driven justifications for their choice. These justifications include:

1. Relevance of the chosen biomarker to a specific concept of operation for which continuous/on-demand monitoring is advantageous;

2. Proven correlation between the chosen biomarker concentration levels in the biofluid from which it is extracted compared to plasma, and
3. Physiologically and operationally relevant range of biomarker concentration and assessment that the chosen approach can measure with appropriate range and precision.

Furthermore, proposers should provide a maturity level analysis on the fluid collection methodology and justify its applicability for situations of low physical exertion. Proposers should demonstrate that their approach to biomarker sensing and overall wearable solution is suitable for continuous and on-demand monitoring for a monitoring frequency of at least every 30 minutes. Clinical studies to establish biomarker/health status correlations are outside the scope of this work, however, collaborations outside of the NextFlex-funded project in support of such studies are highly desired and encouraged.

Proposers should show the benefits of FHE technologies from both manufacturability and user comfort standpoints. Twenty-five (25) TPD prototypes should be delivered at project completion.

The resulting deliverable hardware must satisfy the following criteria:

- Any sampling and sensing modality must be flexible or conformable
- The manufacturing process for FHE components or the integration of the sampling sensors into an FHE device must be able to be reproduced using the process line at the NextFlex Technology Hub in San Jose, CA, or comparable facilities, or the prototype must be able to be integrated into an FHE multisensory platform using established manufacturing techniques.

Proposals must include an assessment of acceptable cost for the projected use case, and a cost analysis for manufacturing at scale. It should also indicate whether the proposed solution is a fully disposable system, partially reusable, or a fully reusable solution.

Ideal proposals should seek to demonstrate an additively manufactured or system integrated/printed microfluidic or microneedle or comparable sampling solution that can be integrated into the FHE system. Key functionalities of the integrated device should include either:

1. Integrated sensing elements within the device that can take continuous measurements with static fluid access, or
2. Active fluid control such as pumping, valving, metering, and sensing, realized from primarily printed / additively manufactured methods.

Other desired functionalities are lysing, rinsing, anti-fouling surfaces as appropriate. Device must demonstrate “flex” (bend radius of 25 mm or less). Ideal solution may contain stretchable devices with elongation of at least 10 percent. Full operating performance must be maintained during these mechanical deformations.

PC Topic TPD 4.9: Lightweight Flexible Electronics Platform for UAVs and Drones

$850,000 maximum government funds / Up to an 18-month duration

This topic seeks to develop a lightweight electronics platform demonstrator using FHE manufacturing that serves multiple functions needed for airborne platforms such as micro-UAVs.

These multiple functions must be integrated together and could include:

- Power conversion (e.g., solar cells, receivers for beamed power)
- GPS
- Communication (send/receive signals)
- Counter-UAV

The demonstrated electronics platform should:

- Produce a significant net reduction of weight over traditional, separate systems with the same multi-functionality.
- Be flexible and adhere to the body of the micro-UAV or other airborne asset minimizing aerodynamic drag.
- Include lightweight batteries or capacitors for energy storage.
- Demonstrate at least one power conversion function.
- Demonstrate at least one communication function.

The method for accumulating power/energy, a rough efficiency calculation, and the communication methodology must be described and demonstrated. Flight endurance of at least 45 minutes is required, and the UAV and FHE electronics are expected to survive typical operating conditions throughout repeated launch, flight, and landing. The program is expected to deliver a minimum of 10 working FHE systems as well as two UAV assets with the complete functionality integrated. For any communication elements, the communication distance must be reasonable for a 45-minute flight endurance and (i.e., greater than 5000 m under line-of-sight conditions)

Proposals that include external DOD agency funding or in-kind support for technology solutions to specific DOD requirements or direct funding from a separate commercial business unit will be prioritized. The requirement for additional DOD agency funding can be executed through the NextFlex cooperative agreement or a separate agreement or contract. For information related to DOD labs or agencies willing to support proposals in this area with in-kind resources, please contact NextFlex at: proposal@nextflex.us.

SECTION 5. PROPOSAL SUBMISSION PROCESS

5.1 Proposal Format Guidelines

To maintain consistency through submission, review, and approval processes, please follow guidelines:

Submission. The proposer shall submit one (1) word-processed electronic copy of their proposal via online submission form at https://www.nextflex.us/project-call/project-call-4/submission-form/.

Figures, Graphs, Images, and Pictures. Figures and tables must be numbered and referenced in the text by that number. They should be of a size that is easily readable and may be in landscape orientation. They must fit on an 8.5 by 11-inch paper size.

Font. Proposals are to be prepared with easy-to-read font (such as Times New Roman or Arial), 10-point minimum), single-spaced. Smaller font may be used in figures and tables but must be legible.

Page Layout. The proposal document must be in portrait orientation except for figures, graphs, images, and pictures. Pages shall be single-spaced, 8.5 by 11 inches, with at least one-inch margins on all four sides of each page.

Page Limit. The main body is limited to six pages for the pre-proposal and 25 pages for the full proposal. The page limit includes table of contents (if included) and the required sections within the proposal. The page limit does not include the cover sheet and relevant appendices. Pages that exceed these guidelines may not be reviewed.

Proposal cost calculations should be in the Excel format provided. In addition to the PDF version of the spreadsheet attached to the word-processed document, the spreadsheet should be included as a separate file along with the submission.

Page Numbering. Number pages sequentially within each section of the proposal showing proposal section and page number.

Summary PowerPoint Slide. Each team is required to provide a single PowerPoint slide for their proposal which outlines proposed budget, funding, duration, objective, and deliverables, to be used by the Technical Council while reviewing the projects for selection. Graphics or other relevant and impactful material is often helpful in this regard. A template for this slide may be downloaded at: www.nextflex.us/project-call/project-call-4/.

5.2 Project Call 4.0 Timeline

The project selection process will occur in two steps. The first step is that a pre-proposal will be evaluated for important early feedback from the evaluation team and to minimize the investment of time and energy into out-of-scope proposals. The second stage is that certain pre-proposals will be invited to submit a full proposal. Key steps and target dates are outlined in the table below.

Project Call Announcement and Posting	Aug 6
Optional PC 4.0 Webinar	Aug 7
PC 4.0 Overview, Networking, and Teaming Event	Aug 8
Pre-Proposal Online Cover Sheet Due	Sep 25
Pre-Proposal Submission Deadline	**Oct 2**
Full Proposal Online Cover Sheet Due (if invited to submit full proposal)	Jan 8
Full-Proposal Submission Deadline	**Jan 15**
Anticipated Technical Council Review	Feb 12
Anticipated Governing Council Review	Mar 1

5.3 Pre-Proposal Guidelines

The pre-proposal table of contents and guidelines are provided in this section. Please follow instructions in section 5.1 for format and other requirements. To keep the main body of the proposal succinct and consistent, please provide supporting tables as appendices. Use the standardized cover page format (Appendix A). The table of contents for the pre-proposal is outlined below. If required, additional tables may be included. Please ensure that all table or figure references include a clear numbering system and are cross-referenced in the proposal text. Please ensure that proposals clearly identify the current capability and the quantitative target specifications that will determine success of the project.

It is imperative that proposals define milestones that are tangible, measurable, and demonstrable. The specifications of each milestone achievement must be clearly defined as well as the starting state of the art for the same features that the project is improving upon. Examples of tangible milestones may include physical samples, written reports containing collected data, or live demonstrations of functionality.

Pre-Proposal Table of Contents

Not Included in the Page Count	
Page I	Cover Page (complete and reproduce the Table shown in Appendix A)
Page II	Table of Contents
Page III	Executive Summary: A succinct summary of **no more than one page** clearly articulating the big picture problem being addressed, proposal objectives, relevance to FHE, approach to address all critical technical and non-technical aspects, expected outcome, and overall cost/cost share information.

Pages 1-6: Proposal Content There is a six-page maximum for the pre-proposal, excluding appendices and PowerPoint Slide Project Description; the page count in each section is for guidance. Total number of

pages is more important than the page count in each section. The contents for the pre-proposal are given below.

Proposal Content – 6-Page Maximum for Sections 1-7; Sections 8-9 are **Excluded** from Page Count	
Suggested Length	**Section and Contents**
~1 Page	**1. Background and Need** 1.1. FHE Opportunity and Proposed Solution 1.2. Background and Current State of the Art 1.3. Gap Analysis and Problem Definition
~2.5 Pages	**2. Technical Objectives, Scope, and Approach** 2.1. Technical Objectives 2.2. Technical Scope and Approach 2.3. Innovative Claims 2.4. Performance Metrics
~0.5 Pages	**3. Work Plan** 3.1. Project Schedule (need only overall duration with high level milestones)
~0.5 Pages	**4. Commercialization Strategy** 4.1. TRL/MRL Assessment (current state of the technology and expected level to be achieved) 4.2. Business Case for Proposed Technology (including relevance to the FHE ecosystem) 4.3. Manufacturing Partners and Approach 4.4. Tool Accessibility to NextFlex Members and Broader Ecosystem (for manufacturing/test tools and software tools only)
~0.25 Pages	**5. Budget Justification and Cost Share** 5.1. Labor, Materials, Overhead (no details needed for pre-proposal, only budgetary estimate of Total Cost, Cost Share, and Federal Funds Request)
~0.5 Pages	**6. Capability to Meet Technical and Business Goals** 6.1. Key Personnel Experience and Qualifications 6.2. Prior Work Toward this Specific Effort (brief statement) 6.3. Relevant Facilities and Equipment Infrastructure (brief list of a few critical items in the pre-proposal)
Brief Statement	**7. Workforce Development** 7.1. Education and Training Component of the Proposal
As Needed; Excluded from Page Count	**8. Appendix** 8.1. Bio-Sketches (brief for each team member/org) 8.2. Details of Facilities and Infrastructure Relevant to the Proposal 8.3. Technical References and List of Patents
Excluded from Page Count	**9. Single Page PPT Slide Project Description (format provided)**

Pre-proposals will be accepted online at https://www.nextflex.us/project-call/project-call-4/submission-form/ until **5:00 PM PACIFIC TIME** on **October 2, 2018**.

Please note that this is not a typical government grant or contract opportunity. NextFlex staff are available and encourage clarifying questions and will provide guidance during the process of the proposal preparation.

5.4 Full Proposal Guidelines

A full proposal is an expanded version of the pre-proposal with detailed explanation and supporting documents. While the funding requested in the full proposal can be less than what was requested in the pre-proposal, it cannot increase by more than 10 percent of that requested in the pre-proposal and any increase should be supported by justification. The main body of the full proposal should be limited to 25 pages—excluding cover sheet and appendices. Please follow the instructions in section 5.1 for format and other requirements where proposers may find the requested table of contents and guidelines for each section. Please keep the main body of the proposal succinct and clear in each section to improve the quality of the review process. Proposers may provide supporting tables and data in the appendices. Please ensure that any table or figure references includes a clear numbering system. **Please ensure that proposals clearly identify the current capability and the quantitative target specifications that will determine success of the project.**

Content: The proposal shall comply with the following content and structure. Importantly, the budget sheets must be filled out completely and consistent with format provided.

Full Proposal Table of Contents

Not Included in the Page Count	
Page I	Cover Page (see Appendix A)
Page II	Table of Contents
Page III-IV	Executive Summary: A succinct summary of **no more than two pages** clearly articulating the big picture problem being addressed, proposal objectives, relevance to FHE, approach to address all critical technical and non-technical aspects, expected outcome and overall cost/cost share information.

Pages 1-25: Proposal Content There is a 25-page maximum for the full proposal, excluding appendices and PowerPoint Slide Project Description; the page count in each section is for guidance. Total number of pages is more important than the page count in each section. The contents for the full proposal are given below.

Proposal Content – 25-Page Maximum for Sections 1-7; Sections 8-9 are **Excluded** from Page Count	
Suggested Length	**Section and Contents**
~2 Pages	**1. Background and Need** 1.1. Identify the FHE Opportunity and Proposed Solution 1.2. Describe Background and Current State-Of-The-Art 1.3. Gap Analysis and Problem Definition
~5 Pages	**2. Technical Objectives, Scope, and Approach** 2.1. Technical Objectives 2.2. Technical Scope and Approach 2.3. Innovative Claims 2.4. Performance Metrics (to assess the deliverables for outcome) 2.5. Key Target Specifications (for critical technical outcome)
~5 Pages	**3. Work Plan** 3.1. Project Schedule 3.2. Detailed Description of Milestones, Tasks, and Deliverables 3.3. Project Risk Assessment and Mitigation Plan 3.4. Project Management Approach, Roles, and Relationship of Key Personnel
~4 Pages	**4. Commercialization Strategy**

	4.1. TRL/MRL Assessment (current state of the technology and expected level to be achieved and explanation of how the proposed work will advance the TRL/MRL) 4.2. Market Analysis and Business Case for Proposed Technology (including relevance to the FHE ecosystem) 4.3. Manufacturing Partners and Approach 4.4. Tool Accessibility to NextFlex Members and Broader Ecosystem (for manufacturing/test tools and software tools only) 4.5. IP: Existing Portfolio and Future Strategy (related to the proposal topic)
~1 Page	**5. Budget Justification and Cost Share (back-up workbook in the appendix)** 5.1. Labor (by staff position), materials, and overhead, including overhead rates, each divided by source of funds. Must use the NextFlex PC 4.0 Cost Calculations spreadsheet for required format. Attach tabs to the spreadsheet with detail behind the summary figures. 5.2. Value and Quality of Cost Share
~3 Pages	**6. Capability to Meet Technical and Business Goals** 6.1. Key Personnel Experience and Qualifications 6.2. Prior Work Toward This Specific Effort 6.3. Relevant Facilities and Equipment Infrastructure (pertinent to the proposal – list a few critical items in the pre-proposal) 6.4. Three-Year Financial Performance Track (not applicable to established corporations/ academic institutions)
~1 Page	**7. Workforce Development** 7.1. Education and Training Component of the Proposal
As Needed; Excluded from Page Count	**8. Appendix** 8.1. Bio-sketches 8.2. Facilities and Infrastructure Relevant to the Proposal 8.3. Technical References and List of Patents 8.4. Letters of Support 8.5. Budget Workbook per Attached Workbook Template
Excluded from Page Count	**9. Single Page PPT Slide Project Description (format provided)**

SECTION 6. ADMINISTRATIVE TOPICS

6.1 Confidential Information

It is recognized that it may be desirable to include information that is considered confidential and proprietary by the submitter to fully and effectively convey the technical merits of the proposal. While a best effort will be made to restrict the proposal information to those with a need to know expressly for purposes of the review, it is recommended that the inclusion of proprietary information be clearly marked and be limited to the minimum necessary to convey the highlights of the technical approach.

6.2 Financial and Cost Share Requirements

Development agreements generally will be awarded as cost reimbursement, not-to-exceed contracts, with payments to be made on achievement of milestones as presented in the proposal. If the proposer's organization has a US government-approved rate structure, please use it. The methods used to value "cost sharing" must be the same as those used to value the full project costs. All suppliers are expected to have a government approved or industry standard accounting system by which actual project costs are tracked and reported. This is an absolute requirement to be sure that cost share obligations are met. Overall guidance on the working principles and requirements of cost-share (in-kind cost share, and cash and cash equivalent cost share), including various regulations governing federally funded programs are given in a

separate document, "Cost Share Definitions and Guidance," available at www.nextflex.us/project-call/project-call-4/.

6.3 Work Requirements

To submit a response to PC 4.0 and to subsequently be considered for an award, the following requirements must be met:

- Proposal teams should include at least one corporate/industrial organization and are encouraged to be industrially led when appropriate.
- The company or composite team of companies/government labs/academics must have a significant presence in the US in the form of R&D activities and/or manufacturing. One hundred percent of the work activity (funds) must be spent within the United States operations.
- The company or companies must be committed to delivering the developed products and provision to the US flexible hybrid electronics and systems manufacturing industry on a right-of-first acceptance basis. Applied research conducted by universities will be considered and does not need to meet this requirement. However, in the latter case, a pathway to commercialization must be envisioned and described.
- Process development projects should include sufficient documentation that the method is replicable at the NextFlex Technology Hub in San Jose, CA, or member company's facility or both as appropriate.
- Test methods, materials data, or design tools should be foundational and available for incorporation into tools for the advancement of FHE and not limit collaboration.
- The total project funds must be matched at a minimum of 1:1. Teams may determine how to divide that requirement among their members. The cost share is defined in the Participation Agreement to include matching share of the development cost in cash and in-kind contributions, e.g., labor and materials, of at least 50 percent. The funding requested in the full proposal can decrease but cannot increase by more than 10 percent of that requested in the pre-proposal.

6.4 Membership Requirement

To qualify for funding awards, companies, organizations, and their partners that are selected for an award and who are not already a member of the Institute, must subsequently join NextFlex at the appropriate membership level (not Observer Level). Only the suppliers from whom standard parts, components, or materials are acquired based on a part number from their catalog are exempted from this requirement. It is the responsibility of the project lead(s) to communicate this requirement to their respective partners and coordinate their membership process with NextFlex. Potential members can find out more at: https://www.nextflex.us/get-involved/membership-inquiry-form/.

SECTION 7. PROPOSAL EVALUATION CRITERIA

7.1 General

The members of the NextFlex Technical Council comprised of SMEs from industry, government, and academic institutions will evaluate and prioritize all proposals and provide feedback to the winning teams. They may make recommendations for proposal modifications to some teams as appropriate. In soliciting these proposals, NextFlex plans to grant and administer funding that must be matched (1:1 minimum) with funds in the form of cash and in-kind contributions provided by the grant recipients to cover the total project cost. It is not a requirement that each team member demonstrates a cost share at a minimum of 1:1. However, the entire project must be cost-shared at least 1:1, and ratios greater than 1:1 are highly encouraged.

Project teams with skilled technical expertise from NextFlex member organizations will be identified to provide project oversight and direction. These project teams typically will be comprised of one to two experts from NextFlex member companies, government laboratories, and other members.

In responding to this solicitation, partnering among industrial companies or industrial company/R&D organization/university/government teams is encouraged. Individual company responses may be appropriate where company size, breadth, and expertise are sufficient to cover effectively all areas (e.g., technical resources, financial stability, and market presence) critical to the successful delivery of the product demonstrator or material proposed. Such an engagement with industry partner(s) will strengthen the value of the submission.

Pre-Proposal Evaluation: The purpose of this evaluation is to rank all competitive submissions with respect to overall proposal quality as relevant to the project call topics, value proposition, overall approach, and relevance to FHE, cost share, workforce development, and the strength of committed industry partnership and the team. The proposals will be reviewed by a team of SMEs, ranked, and only those down-selected will be advanced to submitting a full proposal. The number of proposals advanced will be governed by the allotted budget and goals of the project call.

Full Proposal Evaluation: During the final selection process of full proposals, communication between the proposers and NextFlex may be initiated over the terms, conditions, specifications, deliverables, schedule, or other relevant factors contained in the proposal in advance of awarding of a contract. (Granting of awards to proposals submitted in response to this Project Call is contingent upon the continued availability of US government funding)

The scores and comments from different reviewers on all proposals will be compiled, ranked, voted, and prioritized by the Technical Council. They may seek additional modifications before making the recommendations to the Governing Council. Upon approval by the Governing Council, the proposal shall advance to executing Partnership and Development Agreements prior to awarding any funds.

Both pre-proposals and full proposals are evaluated based on the criteria as outlined in the table below. The lists of criteria for both are aligned with sections in the proposal Table of Contents. Since the pre-proposal is limited in detail (and number of pages), some of the criteria are combined for evaluation purposes. The explanations for the criteria in Appendices C and D provide guidelines to the submitters as well as the reviewers regarding relevant information and supporting details to be included in submissions at the pre-proposal and full proposal stage.

Section	Section Title	Criteria
1.0	Background and Need	(1) Problem statement and innovative solution
2.0	Technical Objectives	(2) Technical scope and approach
		(3) Logical technical plan; key deliverables and specifications
3.0	Work Plan	(4) Project organization
		(5) Probability of success
4.0	Commercialization Strategy	(6) Business case/value proposition
		(7) MRL/TRL assessment
		(8) Manufacturing approach
		(9) Tool accessibility (hardware and software proposals only)
5.0	Budget Justification and Cost Share	(10) Cost and cost realism
		(11) Value and quality of cost share
6.0	Capability to Meet Technical and Business Goals	(12) Experience of personnel and quality of relevant facilities
7.0	Workforce Development	(13) Quality of WFD section

Proposals that include use of the Technology Hub should articulate the value proposition. Utilizing the Technology Hub is not an evaluation criterion. The Technology Hub utilization in a proposal may be included in context with: technical strategy leveraging state-of-the-art FHE capabilities, commercialization strategy, industry-relevant transition of manufacturing processes, and demonstrating manufacturing gaps through a TPD. All projects are encouraged to leverage the NextFlex technical staff expertise.

Workforce Development: Establishing a domestic manufacturing ecosystem in FHE will require not only the development of new manufacturing processes, but also training a workforce to design and manufacture FHE products. To that end, proposals that include a Workforce Development (WFD) component geared toward training tomorrow's workforce, retraining today's workforce, and/or K-12 STEM outreach activities are favorably considered. WFD may include, but is not limited to, undergraduate and graduate student contributions to projects, FHE internships, FHE course development at community colleges or universities, short course development, the development of STEM programs, etc.

SECTION 8. CONTACT INFORMATION

Communication and questions during the proposal period and submission of proposals should be directed by email to proposal@nextflex.us.

SECTION 9. REFERENCE DOCUMENTS KIT

All the following eight (8) reference documents are in the Project Call Reference Documents section of the PC 4.0 webpage (www.nextflex.us/project-call/project-call-4/):

a. Project Call 4.0
b. MRL/TRL Definitions
c. Cost Calculations Template
d. Cost Share Definitions and Guidance
e. Membership (https://www.nextflex.us/get-involved/membership-inquiry-form/)
f. Summary PPT Submission Template
g. Online Cover Sheet (https://www.nextflex.us/project-call/project-call-4/cover-sheet/) – Pre-proposal Cover Sheet must be submitted by September 25th. If invited to submit a full proposal, a second Cover Sheet must be submitted by January 8th.
h. Online Submission Form (https://www.nextflex.us/project-call/project-call-4/submission-form/)

SECTION 10. GLOSSARY OF TERMS

Abbreviation	Term
ADP	Agency Driven Project
CAD	Computer-Aided Design
COTS	Commercial Off-the-Shelf
DOD	Department of Defense
EDA	Electronic Design Automation
FHE	Flexible Hybrid Electronics
FSS	Frequency Structural Simulator
GC	Governing Council
IC	Integrated Circuit
MRL	Manufacturing Readiness Level
MTA	Manufacturing Thrust Area
OEM	Original Equipment Manufacturer
PC	Project Call
PCB	Printed Circuit Board

PDK	Process Design Kit
PI	Principal Investigator (i.e., leader for a project)
R&D	Research and Development
RF	Radio Frequency
SME	Subject Matter Expert
SMT	Surface-Mount Technology
STEM	Science, Technology, Engineering, and Mathematics
TC	Technical Council (comprised of SMEs and Tier 1 and Tier 2 members from industry and academia)
TPD	Technology Platform Demonstrator
TRL	Technology Readiness Level
TWG	Technical Working Group
UAV	Unmanned Aerial Vehicle
WFD	Workforce Development

APPENDICES

Appendix A: Cover Sheet Template

The chart below is to help you anticipate what information will be requested for your cover sheet. To generate a cover sheet, which will be attached to front of the proposal, please fill out the form at www.nextflex.us/project-call/project-call-4/cover-sheet/.

NextFlex PC 4.0 Cover Sheet Template	
Project Title	
Date of Submission	
Proposal Stage (Pre- or Full Proposal)	
Project Leader	
Organization, Department, and Address	
DUNS Number	
Phone Number	
Email Address	
Non-Industry Partnering Organization(s)	Provide full name, location, and other details
Industry Partnering Organization(s)	Provide full name, location, and other details
Supplier/Subcontract Organization(s)	
Project Topic Category	
MRL Level - Start/Finish	Include both start and finish levels
TRL Level - Start/Finish	Include both start and finish levels
NextFlex Membership Status and Level	
Total Project Cost:	$
Cost Share (in-kind, labor, material, etc.)	$
Cost Request from NextFlex	$
Project Duration	XX months

Appendix B: Instructions for Filling Out Proposal Cost Calculations Excel Workbook

In consequence of federal funding for Institute projects, there are specific requirements for planning and tracking proposal spending. To support those, please lay out the project financials in the provided format. While budget details will be entered into the Excel tables provided, the following should serve to clarify what needs to be documented and how:

Overall the following areas are important for the Institute to understand:

- Total project cost
- Total cost share, including percent and amount of funding requested from NextFlex
- Type of costs
- In-kind contributions and types thereof
- Hours and rates for labor
- Any equipment purchases planned
- Materials purchases
- Travel expenses

In addition to detail on the above, the Institute will need to know spending by calendar year for which the project operates and a breakdown by lead and partners.

Therefore, the following explanation may be helpful.

Please add columns to the tab entitled “Project Detail” for additional columns needed for “Funds Year 20xx” and “NextFlex Funds Year 20xx.”

Add additional “Project Detail” and “Cost Detail” tabs for each partner on the project, and please make sure to maintain one “Project Detail Total” and “Cost Detail Total” tab which summarizes the partner breakdown.

The primary objective of this supporting workbook for the project proposal is to ensure that the review process can adequately identify all details of the proposal. Proposals that advance to funded projects will be subject to further documentation and record retention requirements which will be detailed to the project lead at that point in time.

If the lead or any partners of the proposal team have audited indirect rates for labor, please use those.

If there are any additional questions on how to prepare the cost calculations workbook, proposers may contact proposal@nextflex.us for further clarification.

Appendix C: Pre-Proposal Evaluation Criteria

PC 4.0 Pre-Proposal Project Review Criteria / Score Card - for TPD and MTA Proposals
Project Topic and Title: PC 4.0
Score Guide: Low=1, High=5

Criteria - for TPD and MTA					
Section	**Section Title**	**Criteria**	**Explanation for Pre-Proposal**	**Example Score**	**Comments**
1.0	Background and Need	(1) Problem statement and innovative solution	Evaluate the problem definition in line with the background information and the gap analysis provided.	3	**Provide succinct overall comments. Highlight strengths and weaknesses with reference to any particular section**
2.0	Technical Objectives	(2) Technical scope and approach	Evaluate based on the alignment between objectives and approach.	5	
		(3) Logical technical plan; Key deliverables and specifications	Is the project plan and approach logically organized? Look for key deliverable and metrics to assess the successful outcome.	4	
3.0	Work Plan	(4) Project organization (5) Probability of success	Evaluate based on the overall duration of the project, cost of the project, and feasibility to achieve the stated goals.	4	
4.0	Commercialization Strategy	(6) Business case/value proposition (7) MRL/TRL assessment (8) Manufacturing approach (9) Tool accessibility (hardware and software proposals only)	How is the technology/product a differentiator or a game changer in the targeted application or market or on US manufacturing? What is the realism of stated MRL/TRL start and end levels in line with the preliminary development and manufacturing paths? Will the demos/equipment/tool/SW/PDK developed as part of the proposal assist the growth of the ecosystem?	1.5	
5.0	Budget Justification and Cost Share	(10) Cost and cost realism (11) Value and quality of cost share	Determine if the overall budget proposed is pragmatic to achieve the goals. Assess based on the cost share value, cost share source and the purpose of the cost share.	4	
6.0	Capability to Meet Technical and Business Goals	(12) Experience of personnel and quality of relevant facilities	Assess the strength of the PI team as well as the partner/subcontract organization; based on proposed WFD objectives and outcome, is it intern, graduate student, or training, etc.?	2	
7.0	Workforce Development	(13) Quality of WFD section			
			Average Score (Example)	**3.36**	

Appendix D: Full Proposal Evaluation Criteria

PC 4.0 Full Proposal Project Review Criteria / Score Card - for TPD and MTA Proposals
Project Topic and Title: PC 4.0
Score Guide: Low=1, High=5

Criteria - for TPD and MTA

Section	Section Title	Criteria	Explanation for Full Proposal	Example Score	Comments
1.0	Background and Need	(1) Problem statement and innovative solution	Evaluate the problem definition in line with the background information and the gap analysis provided.	3	**Provide succinct overall comments. Highlight strengths and weaknesses with reference to any particular section**
2.0	Technical Objectives	(2) Technical scope and approach	Is the objective, scope and approach aligned with the problem definition?	5	
		(3) Logical technical plan; Key deliverables and specifications	Does the specifications and deliverables meet the proposed objectives and final deliverables? What are the key tangible deliverables and how do we assess success?	5	
3.0	Work Plan	(4) Project organization	Is the project organized well with milestones and tasks; Are the task descriptions clearly articulated: Is the schedule aligned well with critical interdependencies identified?	4	
		(5) Probability of success	Based on all of the above, including the cost and the team capability, assess the feasibility to achieve the stated goals.	3	
4.0	Commercialization Strategy	(6) Business case/value proposition	Are the starting MRL/TRL accurate? Are the end MRL/TRL assessed correctly, and is it realistic considering the overall quality of the project and maturity of technology and approach? How does it impact US manufacturing?	5	
		(7) MRL/TRL assessment	What is the targeted application or market? How is the technology/product a differentiator or a game changer?	4	
		(8) Manufacturing approach	Is the technology/approach matured and ready for manufacturing? Is it the right approach? Does it help advance the MRL/TRL goals? Do they have the right partners? Are they US-based? How is the maturity of process and/or manufacturing infrastructure?	5	
		(9) Tool accessibility (hardware and software proposals only)	Evaluate based on if the demos/equipment/tool/SW/PDK developed as part of the proposal will be available to the ecosystem, and where they will be located.	3	
5.0	Budget Justification and Cost Share	(10) Cost and cost realism	Evaluate if the cost assessment is pragmatic based on the overall assessment of the project inline with its objective, team, advancement, timeline etc.	4	
		(11) Value and quality of cost share	Assess based on the cost share value, cost share source, and the purpose of the cost share.	4	
6.0	Capability to Meet Technical and Business Goals	(12) Experience of personnel and quality of relevant facilities	Assess the strength of the PI team as well as the partner/subcontract organization and evaluate the proposal based on the set goals.	4	
7.0	Workforce Development	(13) Quality of WFD section	What aspects of WFD is proposed? Is it intern, graduate student, or training etc.?	2	
			Average Score (Example)	**3.92**	