

Natcast



Test Vehicle Innovation Pipeline (TVIP)

Call for Proposals (CFP)

Funding Opportunity Number: NAT-RD-24-0002

Issued August 28, 2024

Revision History

| Date | Author | Change |
|-----------------|---------------|-------------|
| August 28, 2024 | Program Staff | Version 1.0 |

NSTC CALL FOR PROPOSALS
Executed by Natcast, the operator for NSTC
Test Vehicle Innovation Pipeline (TVIP)
Executive Summary

Funding Opportunity Title: Test Vehicle Innovation Pipeline (TVIP)

Funding Opportunity Number: NAT-RD-24-0002

Dates: Key dates are given below. Please note: **all submissions are due by 5:00 pm EDT on the specified dates.**

| Activity/Event | Date |
|-----------------------------------|-------------------|
| TVP Informational Webinar | 8/20/2024 |
| TVIP CFP Released | 8/28/2024 |
| TVIP Proposers’ Day | 9/10/2024 |
| TVIP Concept Paper Due (Required) | 09/18/2024 |
| Question Submission Deadline | 10/11/2024 |
| Proposals Due | 10/21/2024 |
| Target Awards Announced | Feb-25 |
| Target Project Start | Apr-25 |

Concept Paper: Submission of a maximum 5-page concept paper is required for submission of a full proposal. Recipients will receive feedback encouraging or not encouraging a full proposal within 10 days of submitting a concept paper. Concept papers should list the project’s title, proposer’s team, principal investigators, team point of contact, and estimated budget. The composition of the team can change between concept paper submission and proposal submission. Concept paper submissions should include a summary of the proposed technical agenda and will be evaluated against the first two criteria laid out in section 5.1.

Concise Description of Funding Opportunity: This NSTC research and development program will address the needs of researchers, entrepreneurs, and developers at commercial fabrication facilities by leveraging economies of scale and standardization to rapidly develop and benchmark new technologies at different Technology Readiness Levels (TRLs). The program’s objective is to create interrelated test vehicles suitable for different TRLs within several technology areas. The goal of the TVIP funding opportunity (the “TVIP program”) is to have a portfolio of test vehicles and related resources (the “Test Vehicle Repository”) that will be available to NSTC members for future use.

Anticipated Amounts: Total program award funding up to \$55M with 4-12 awards is anticipated. Individual awards are anticipated to range from \$1M to \$20M.

Eligibility: Applicants must be NSTC members at the time of award and must be eligible to become NSTC members to submit proposals. Additional information about NSTC Membership and the process for becoming a member will be available in the coming months. The NSTC expects to make NSTC Membership terms and fees sufficiently accessible for all expected applicants. Eligible applicants include domestic for-profit organizations, non-profit organizations, and accredited institutions of higher education. See Section 3 for additional details on eligibility.

Proposal Submissions: An organization may be the lead on up to 4 total proposals.

Contract Type: Firm-Fixed Price with milestone payments.

Cost Sharing Requirements: None

Public Website and Frequently Asked Questions (FAQs): <https://natcast.org/research-and-development/tvip>

Teaming Opportunities: Teaming is highly recommended.

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1. Funding Opportunity Description

1.1 Introduction

The National Semiconductor Technology Center (NSTC) was established pursuant to the CHIPS Act as a public-private consortium dedicated to semiconductor R&D in the United States. The NSTC will convene the U.S. government, allied and partner nations, and organizations across the semiconductor ecosystem—including academia and businesses of all kinds—to address the most challenging barriers to continued technological progress in the domestic semiconductor industry, including the need for a capable workforce. The NSTC reflects a once-in-a-generation opportunity for the U.S. to drive the pace of innovation, set standards, and re-establish global leadership in semiconductor design and manufacturing. Natcast is a purpose-built, non-profit entity created to operate the NSTC serving as the focal point for research and engineering throughout the semiconductor ecosystem, advancing and enabling disruptive innovation to provide U.S. leadership in the industries of the future.

One key challenge that the NSTC seeks to address is the “lab-to-fab” transition, or the overcoming of the barriers encountered by developers at commercial fabrication facilities, researchers, and entrepreneurs to bring promising technologies from conception into mass production. One measure of the “lab-to-fab” transition is the Technology Readiness Level (TRL), a 9-level metric where TRL 1 represents the observation of a principle and TRL 9 represents that the technology is experimentally proven and ready to be moved into mass manufacture. NSTC sponsored research intends to help migrate technologies from TRL 3-4 (demonstration in a laboratory environment), through TRL 5-6 (demonstration in a relevant environment) to TRL 7 (demonstration in an industrial environment (i.e., a 300 mm prototype facility)). A major barrier is that the movement from TRL 4 to TRL 5 may require the use of foundry resources such as test chips and wafers, also known as **test vehicles**, which can be prohibitively expensive and time consuming to acquire and process relative to the risk and availability of capital for the technology under development. In some cases, developing a test vehicle may take longer than the actual underlying research program. The transition from TRL 4 to TRL 5 may also present significant risks for foundries and prototype facilities, such as material/process compatibility issues, or contamination and particle generation, which could disrupt production lines.

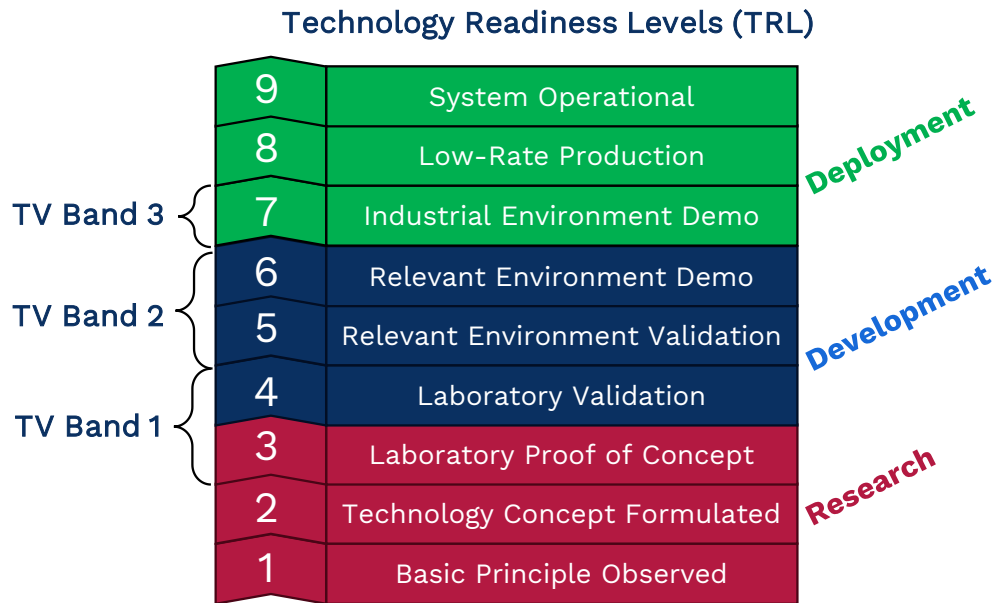


Figure 1: The Technology Readiness Levels. Note, TV Band 1, 2 and 3 depict the three TRL bands which will be important for this proposal, TRL 3-4, TRL 5-6, and TRL 7. The technology readiness levels provide a qualitative metric for how to assess the progression of technology.

To address these challenges, the goal of the Test Vehicle Innovation Pipeline (TVIP) is to develop standardized, interrelated sets of test vehicles which can be used across the TRL 3-7 range, both within NSTC member’s laboratories at a coupon scale (TRL 3) through introduction into a 300 mm pilot line or R&D annex (TRL 7). In practice, these test vehicles can be initially manufactured in commercial foundries or large research facilities and then sent out for additional processing in a research laboratory. This would represent a low TRL 3-4 type of process flow. If the test vehicle is reintroduced to the source facility or processed within the source facility but with a new technology introduced, this would be considered a high TRL 7 type of process. Proposers shall identify an emerging subject technology of interest (e.g. new gate stack materials, memory devices, interconnects, back-end transistors, unit etch processes, etc.), and produce a complete set of resources, including one or more TRL-matched test vehicles spanning the full TRL 3 to TRL 7 range.

These shareable platforms will be designed to rapidly screen particular instances of a new technology through split-fab fabrication in a research laboratory or material introduction into a new facility so as to swiftly advance as many as possible into a more advanced prototyping line.

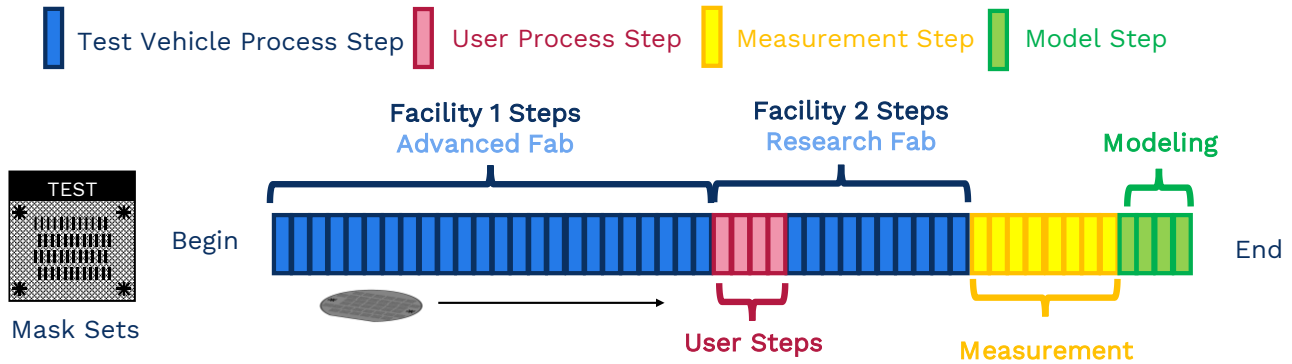


Figure 2: Exemplary split fab test vehicle. This example includes a mask set with a design matched to a process design kit from an advanced fab like a commercial foundry. After a subset of the full CMOS manufacturing process, the wafer is pulled mid-production and sent to separate research fab. The research fab introduces a novel new process or material and then continues to process the wafer. After processing, the test vehicle wafer is measured, and the data is analyzed.

In addition to the core test vehicle capability, which should be composed of designs, mask sets, film stacks, enabling process flows, and integrated circuits; performers will also need to develop complementary documentation, measurement capability, and data analysis capability. Documentation should address key elements of how to use the test vehicle. Critically, such documentation should also formalize the protocols, criteria, and measurements for addressing incoming and outgoing wafers to a facility as well as the material/process compatibility issues when introducing new technologies into a facility.

Moving wafers between facilities can be cost effective, as opposed to introducing a new process or material, but increases risks. Equally important, complementary measurement and data acquisition capability should reduce the time and cost of developing and validating datasets using ready-made documentation/software for commercial vendors or integration with automated measurement systems. Likewise, such data should have a well-defined data analysis flow, including integration with technology computer aided design (TCAD) software, computer vision, or fitting of electrical data. The ultimate purpose of the TVIP deliverables is the creation of a TVIP Repository that will be available to NSTC members after the TVIP funding program is over.

Proposing teams should include a membership capable of successfully completing the program as defined and subsequently transitioning the deliverables for the benefit of the NSTC membership.

In order to evaluate proposals, Natcast intends to score proposals based on their relevance to three TRL bands, as broadly, and not-strictly defined below:

- TRL 3-4, lab finished devices which are intended to be processed by laboratory scientists at a coupon scale, for example using direct write technology (e-beam, laser writer, contact, etc.)
- TRL 5-6, relevant environment finished test vehicles which might involve wafer scale processing of cored wafers from 100 mm to 200 mm involving more complex process integration. This could also include 300 mm processing of a subset of full flow modules.
- TRL 7, industrial environment test vehicles in which performers must demonstrate a test vehicle which allows for the introduction and evaluation of a new technology in an advanced facility

1.2 Motivation

Test Vehicles are necessary for the transition of semiconductor technologies from lower to higher TRLs. However, the cost of producing a test vehicle is often prohibitive and exceeds the investment money available from Small Business Innovation Research (“SBIR”) grants or seed level investment from a venture capital fund. Consequently, from a pool of what might be many very similar projects, only a relatively small number of projects will be able to advance to the next TRL through investment from a major company, the US government, or from private investors. This can leave many promising projects behind while creating greater risks (with concomitant lower financial returns) for developers advancing specific technologies. In many instances, where similar projects can share test vehicles, leveraging common resources is more cost-effective, facilitates technology benchmarking, and provides additional opportunities for researchers.

As a public-private consortium, NSTC, is uniquely suited to fund the creation of common test vehicles as a shared resource that can be accessed by researchers working in similar areas. Additionally, the creation of test vehicles under the TVIP program will include 1) complementary measurement capabilities to generate data and 2) full flow data analysis. This can take different forms, such as pre-canned documentation for a third-party metrology company or the creation of a software suite for automatic test probing. Standardizing and automating the data acquisition as part of the test vehicle will reduce the time and cost for members to increase the quantity and quality of their data.

Another barrier to advancing new technologies is manufacturers' reluctance to introduce new, experimental technologies into their facilities, especially when it involves new materials and processes which could produce contamination or particle generation. This is especially the case when doing split-fab prototyping which might involve a wafer flowing into a production facility. A few approaches can be implemented to mitigate this risk, such as formalizing processes, procedures, and tests for assessing the risk of contamination and process incompatibility. In addition, by introducing industrially derived test vehicles at TRL 3-4 and TRL 5-6, new approaches can be developed, such as the introduction of process health monitors (i.e. test structures designed to help detect contamination or thermal budget instability) to help identify problems earlier in the R&D cycle and develop robust standards for material and process compatibility with existing manufacturing processes.

With these various motivations in mind, Natcast invites proposals which would 1) contribute existing test vehicles and IP for use by Natcast and NSTC members through a transition program track and/or 2) create new test vehicles and IP which can be utilized within a few technology focus areas through a generation program track. See Section 1.4 – Scope for additional information about the two program tracks.

To capture a broad range of activities within this specific program, Natcast has prioritized three technology focus areas for new test vehicle and IP creation through a generation track:

- EUV Scale Process Modules for Memory and Logic,
- FEOL/MEOL Materials, and
- CMOS+X/BEOL Test Chips.

These focus areas were selected because, with increasing process complexity, they cover basic process module development, through device-level characterization, to integrated circuits. Proposers with pre-existing mature IP, even if it is not within their three technical focus areas, are encouraged to propose a transition track project. In the future, Natcast may pursue new test vehicle programs in other areas.

1.3 Goals and Outcomes

At the end of the program NSTC members will have access to a new resource: the Test Vehicle Repository, where standardized test vehicles can be sourced from commercial foundries or research fabrication facilities. By sourcing these test vehicles as partial-flow or mid-production wafers ideal for scientific research, NSTC members will be able to

significantly reduce their non-recurring engineering costs by eliminating the need to create their own test vehicles.

By creating a repository of test vehicles and related resources, TVIP hopes to achieve the following goals to advance the semiconductor ecosystem:

- Introducing industrially relevant test wafers at early TRLs to better standardize the risk profile for multi-facility processing and new material/process introduction into advanced research facilities or commercial foundries to minimize disruptions to their existing operations.
- Growing the base of researchers and startups engaged in semiconductor research by reducing non-recurring engineering (NRE) costs in terms of time, risk, and financial resources to move research to higher TRLs, thereby maximizing the value returns of research funding.
- Standardizing the acquisition and analysis of data to better benchmark and guide the development of new technologies through the creation of databases and creation of digital twins.
- Aggregating and increasing the efficiency of disparate research efforts across the country by transforming them into complementary efforts using shared resources.
- Accelerating the introduction of new materials into mass manufacture for commercial products in advanced logic or memory fab so as to improve performance and/or reduce power consumption.
- Incorporating the use of TVIP test vehicles and test vehicle collateral into college-level coursework and workforce programs to train future generations of students and workers.
- Enhancing the diversity of stakeholders and their new technological innovations.

In the TVIP Program, performer teams will either transition silicon proven IP for use by Natcast and NSTC members or build a new fully integrated pipeline of Test Vehicles that span various TRLs, creating a formalized path for technologies to advance from TRL 3 through TRL 8.

1.4 Scope

The scope of the TVIP program is for performer teams to develop or contribute test vehicles for use by Natcast and NSTC members. The process for making this contribution is defined below.

Program Tracks

Proposers can propose to develop IP within two parallel tracks. These tracks are:

Generation Track – New IP is created

- Generation track proposals are expected to meet the totality of the requirements as outlined below.
- Teams should identify a specific subject technology within the 3 technology focus areas.
- Teams should prepare a comprehensive work product spanning TRL bands TRL 3-4, TRL 5-6, and TRL 7 to enable the lab-to-fab transition including addressing metrics of technology performance and materials/process compatibility. This can be done within a single mask set at a single node or possibly three mask sets across multiple technology nodes.
- As a technology advances TRLs, it becomes more difficult to isolate the contributions of or extract isolated details, measurements, or other elements about a subject technology because the test vehicle will likely represent much more integrated processes which have far more interactions with other aspects of the test vehicle processing. Proposal teams, in developing their vehicles, should account for this complexity.
- If the team should elect, for reasons of economy, to include an additional subject technology on their mask(s) within the technology focus area, it could enhance the value proposition of their proposal. However, overly complex test vehicles which do not adequately address any subject area would not be appropriate. In the case of the EUV Scale Process Modules for Memory and Logic technology focus area, it may be the case that multiple material stacks or variations could work with the same EUV scale pattern.
- Teams are free to propose any route (e.g. any CMOS node, any research facility) that is suitable to achieve the program objectives, subject to rules related to foreign collaboration (Section 3.5) and domestic production (Section 2.6).

Transition Track – Existing IP will be updated to meet many of the CFP specifications

- Responders may select which of the **Tasks** below they anticipate seeking to meet and to require funding to accomplish. Proposing teams can participate to solely contribute their IP through the Transition track, and not otherwise participate more broadly in

new IP creation. Such proposals would consist primarily of **Task 5** below but must show evidence they have already completed **Task 4** below.

- Proposals are encouraged to expand the value of their offering by additionally completing **Tasks 3** and **6**.
- Proposers are encouraged to engage in **Tasks 1** and **Tasks 2** for the purpose of adding an additional TRL band to their existing test vehicle but must primarily re-use their existing test vehicle design.
- Proposals will still be evaluated across all the evaluation and selection criteria.
- Proposals for compelling, silicon proven IPs outside of the technical focus areas will be considered for support.

Proposers in the Generation Track can include mature, silicon proven designs to form a comprehensive Generation track proposal.

Tasks

Each generation track performer team will be expected to do six tasks for a TRL-spanning set of Test Vehicles:

Task 1 – Refine and review a subject technology’s requirements across TRLs 3-7

- As part of their initial proposal, a team should have defined a subject technology within one of the three technology focus areas, overall strategy, as well as their potential users. Potential users may submit letters of support which may be added to the appendices (see Appendix 8.1). These users’ needs should span all the accessible levels of the 3 TRL bands (TRL 3-4, TRL 5-6, and TRL 7) targeted in this CFP.
- Based on their initial proposal, the team should now develop a complete technical specification before commencing design. This technical specification should include, but is not limited to, detailed information such as high-level diagrams, design strategies, targeted process flows for each TRL band, a list of types of IP blocks, manufacturing pitches, alignment marks for targeted facilities, feasibility studies results, types of process health monitors, etc.
- Considering the metrics outlined in Section 1.8, the team should consider both the needs to demonstrate high technological performance and the accessibility of the test vehicle.
- The team shall submit their design specification to Natcast for review which Natcast may share with the Independent Verification and Validation (IV&V) team to ensure the program goals are met.

- The technical specification is an early **Go/No-Go** gate for the program.

Task 2 – Design and fabricate first part of test vehicle

- The team should prepare their design for the test vehicles they intend to develop.
- Teams should plan to present periodic status updates to the Natcast team.
- In some cases, it may be best practice to test some IP blocks through a preliminary MPW prototype run, and proposing teams should include this in their plans and timelines, if relevant.
- When the designs are complete, the team shall review their mask set designs with the IV&V team to ensure that the work products meet the requirements from **Task 1**. The review of the Test Vehicle Design against the requirements will be an additional **Go/No-Go** gate for the program.
- In cases where submission to fabrication may include some additional process development, such as for the creation of an EUV Scale Process Module for Logic and Memory, this task may extend beyond the tape-out to include the development of process modules to produce the targeted test vehicle.

Task 3 – Establish a measurement and data analysis capability

- Based on the design in **Task 2**, the team should establish a standardized and, to the extent reasonably possible, automated measurement capability.
- This can include the preparation of pre-canned documentation for comprehensive physical metrology at a commercial vendor or at a research center resulting in standardized data.
- This could include software for automatic probing capability, automatic focused ion beam milling of lamellae sites, etc.
- The team shall establish ideally a script-based workflow for analyzing standardized data prepared which could include access to commercial software APIs (such as TCAD, ab-initio models, image recognition, etc.).
- This could include automatic fitting of etch profiles, automatic statistical analysis of measurement data, or fitting of I/V curves.

Task 4 – Deliver first part of test vehicle to verification and post processing teams

- The team should have members who can enable the characterization and verification of the test vehicles across all three TRL spans (TRL 3-4, TRL 5-6, and TRL 7).

- The teams within each TRL span should perform an experiment demonstrating that the test vehicles function as intended, however, this experiment should not constitute an entirely new research project.
- The teams should document any learning from their experiments to include in the Test Vehicle Manual, including work towards establishing wafer incoming and outgoing criteria as well as establishing material/process compatibility criteria for higher TRLs.
- Experiments should also include the use of the Task 3 data and analysis workflows
- TRL 5-6 teams may need to develop a new process module to integrate the test vehicle into their facility, and these process recipes should be documented for future use.
- Data from the verification teams should be provided to Natcast and the Natcast IV&V team to validate the test vehicle as well as to support the NSTC members' future use of the test vehicle.

Task 5 – Transition TVIP results to the NSTC so that the test vehicles and related resources are usable by Natcast and NSTC members for continued R&D

- Develop a detailed plan for transitioning project results to NSTC, including discussions on productivity gains for researchers, designers, foundries, and others. Incorporate lessons learned from the project execution.
- Provide a step-by-step process for transitioning the test vehicles to NSTC. Include a timeline with key milestones and deadlines. This process should address the continued support and production of test vehicles after the program ends, as appropriate.
- Detail the transfer and maintenance of software/scripts. Explain how these resources can be made available to users, such as through cloud deployment, especially if the workflows depend on existing proprietary software.
- Prepare comprehensive technical documentation, including design documents, source code, user manuals, and technical specifications. Include important information such as quantitative criteria for multi-facility processing of outgoing and incoming wafer procedures, quantitative metrics of process/material compatibility for introducing new materials into a facility, and the use of measurements from **Task 3** to achieve these goals. Provide instructions for use and integration within the NSTC's existing frameworks.

- Assess how the test vehicles can be integrated with other key programs, such as the CHIPS Manufacturing USA Institute, the CHIPS Metrology Program, or the DoD Microelectronics Commons.

Task 6 – Develop a workforce development and curriculum associated with the TVIP program.

- The team should identify important learnings from the TVIP program and develop them into relevant undergraduate and graduate coursework.
- Use of the test vehicles in university fabrication classes is highly encouraged.

Technology Focus Areas

Proposers must select one or more subject technologies within a technology focus area to develop their new test vehicles. These areas have been selected to span across the technology stack from unit process modules, to device development, to integrated circuits. Proposers are free to identify the specific subject technology of their choosing, but technologies of the greatest relevance to semiconductor manufacturers will be scored the most highly. These technology focus areas are:

Focus Area 1 – EUV Scale Process Modules for Memory and Logic

- Proposals might include patterns such as but are not limited to: a random logic pattern, a DRAM pattern, a via pattern, a memory bit pattern, local interconnect pattern or even a more complex derivative composed of a double pattern with pitches at or below 45 nm.
- A proposal might also include an exotic curvilinear or diagonal interconnect pattern not previously explored.
- These patterns could be transferred into or otherwise patterned over film stacks including but not limited to: multi-material templates, multilayer film stacks, a random interconnect underlayer, etc.
- Such films and patterns could be used for diverse applications including but not limited to: area selective deposition, area selective etch, electrochemical deposition, chemical mechanical polishing, plasma etching, epitaxial growth, self-assembly, contact resistance measurements, etc.

An example proposal might propose to create the following elements:

- A TRL 7 embodiment of the vehicle, which is simply the 300 mm wafer, a TRL 5-6 embodiment which is simply the wafer cored to 200 mm, and TRL 3-4 embodiment that is feature mapped to a well-chosen coupon/die size
- A test pattern for a DRAM-like etch as well as a relevant thin film beneath the pattern
- Pre-drafted documentation for doing a partial and full analytical workup of the test vehicle in a commercial lab after being processed in the end user's own facility; the team has partnered with the commercial lab to semi-automate the focused ion-beam etching of lamellae.
- A workflow allowing for automatic extraction of the etch profile from measured data
- A workflow incorporating the extracted etch profile into A TCAD model of the etch process
- Complete documentation of the test vehicle with a GDS file available to NSTC members
- The verification team includes a university doing coupon scale reactor experiments as well as a startup developing a new 300 mm tool.

Reference proposed work outputs 1: The above proposed work outputs are available purely as a reference for proposers for the EUV scale focus area. They do not constitute a recommendation that this specific test vehicle should be chosen.

Focus Area 2 – FEOL/MEOL Materials

- For the purposes of this CFP, a FEOL/MEOL Materials test vehicle is any structure which could be derived from a full set or any subset of steps from a silicon CMOS frontend process flow.
- Proposals might include but are not limited to: a gate replacement test structure, a gate spacer test structure, a S/D epitaxy or contact test structure, structures for testing noise sources, interlayer dielectric structures, a high aspect ratio capacitor structure, or a local interconnect test structure.
- Proposals might consider applications related to reducing gate leakage, reducing contact resistance, reducing wire resistance, improving power delivery, developing new structures/materials to manage thermal transport, reducing parasitic capacitance, improving mechanical or thermal reliability, etc.

An example proposal might propose to create the following elements:

- A commercial high-k/metal gate process where the wafer is pulled from production immediately before the dummy gate removal process and passivated for use as a gate replacement test vehicle
- DC parametric test structures compatible with post-processing in a research lab through use of an extended source/drain to relax the lithographic constraints (TRL 3-4), more advanced test structures including but not limited to structures designed to measure transistor matching and capacitance (TRL 5-6), and a ring oscillator for timing measurements (TRL 7)
- A suite of test structures for process health monitors for 1) ensuring the quality of split-fab processing and 2) ensuring the fundamental material compatibility of the lab introduced processes with the source facility
- Pre-drafted documentation for doing a partial and full analytical workup of the test vehicle in a commercial lab after being processed in the end user's own facility
- Software for automatic probing of the test structures
- Scripted workflow with TCAD models accessible by an API and BSIM model fitting
- Documentation of the test vehicle with a GDS file available to NSTC members.
- The verification team includes a university doing coupon scale materials discovery (TRL 3-4) and a 150 mm or 300 mm research fab (TRL 5-6) capable of doing a 28 nm or similar back end.
- A material/process introduction plan as part of the test vehicle documentation describing how to use the test vehicle (and possibly other tests) for quantitatively assessing whether new gate stack materials are safe to be introduced into either the TRL 5-6 verification facility or the TRL 7 source facility.

Reference proposed work outputs 2: The above proposed work outputs are available purely as a reference for proposers for the FEOL/MEOL Materials focus area. They do not constitute a recommendation that this specific test vehicle should be chosen.

Focus Area 3 – CMOS+X/BEOL Test Chips

- For the purposes of this CFP, a CMOS+X/BEOL Test Chip would be a test vehicle from any CMOS process flow (both silicon and non-silicon) for which there is, in some way, a custom differentiated backend such as through the introduction of a new process/material or a new device in the backend.

- Proposals might include, but are not limited to: characterization of 2- and 3- terminal memory resistive memory, ferroelectric memory devices, BEOL interconnects and metal routing characterization, heat pipes, thin film transistors, 2D-transistors, plasmonic devices, sensors, etc.
- Proposals might consider applications in memory, artificial intelligence, 3D-logic, radio frequency electronics, sensing, power delivery, and thermal management

An example proposal might propose to create the following elements:

- 3 MRAM/RRAM test-chips taped out at the wafer level in 130 nm (TRL 3-4), 45 nm (TRL 5-6), and 28 nm (TRL 7) technology nodes with array sizes of 1Kb, 1MB, and 30MB.
- The chips are designed to be broadly flexible with both external and internal sensing (e.g. with a programmable sense amplifier)
- The 130 nm (TRL 3-4) requires direct integration of devices near the top-most metal layer and requires no user metal routing to operate due to all internal logic being embodied in lower metal layers. Wafers are delivered in a planarized form factor with diverse alignment marks.
- The 45 nm (TRL 5-6) and 28 nm (TRL 7) chips are designed to operate at much higher densities with devices integrated nearer to the FEOL. It also includes some duplicates of the TRL 3-4 structures.
- The 28 nm (TRL 7) chip has process health test features working at TRL 3-4 so that the verification team can check for the unique material compatibility requirements of the 28 nm chip (as opposed to the 130 nm chip) in the lab, even though the overall chip cannot be completed in the lab environment at a coupon scale.
- One or more PCB prototypes the chips can be placed into so as to characterize the memory arrays
- A set of software scripts that has been prepared for analyzing the results from the electrical measurements
- Pre-drafted documentation for doing a partial and full analytical workup of the test vehicle in a commercial lab after being processed in the end user's own facility
- Verification team includes a university (TRL 3-4) and a 150 mm research lab (TRL 5-6)
- A wafer outgoing/incoming plan as part of the test vehicle documentation describing how to use the test vehicle (and possibly other tests) for quantitatively assessing whether a wafer from a separate facility can be introduced into either the TRL 5-6 facility or the TRL 7 source facility.

Reference proposed work outputs 3: The above proposed work outputs are available purely as a reference for proposers for the CMOS+X/BEOL focus area. They do not constitute a recommendation that these specific test vehicles should be chosen. More so, the choice of 3 technology nodes for 3 different test chips is purely illustrative. It is also possible to span all three TRL bands with a single technology node.

Independent Verification and Validation Review

Finally, Natcast will independently contract reviewers to do validation and verification through review of the program materials and possible testing of samples prepared by the Task 4 verification teams. This will include doing review for:

- Creating solutions which are compatible at TRL 3-4, TRL 5-6, and TRL 7 according to the reviewers and a specification provided by Natcast.
- Creating capabilities which are ultimately functional through the delivery of test samples, boards, software, and chips to the IV&V team.

1.5 Program Structure

The TVIP Program will be funded for a period of thirty months. As shown in Figure 3, **Task 1** is expected to be completed before the end of the first quarter; **Task 2** by month 12. It should be noted, that while only 1 tape-out is noted on the calendar, project teams may in fact be submitting multiple tape-outs by this time period if they are producing multiple test vehicles requiring separate reticle sets. All test vehicles spanning multiple TRLs must be developed concurrently to meet the 30 month timeline of the program. **Tasks 2 and 3** are expected to start shortly after **Task 1**. **Task 4** is expected to begin as soon as the samples are returned from fabrication. **Task 5** should begin as soon as contracting has finished. At certain steps, the IV&V team will be brought in to review the progress and work. These include at the end of **Task 1**, the end of **Task 2**, and at the ends of **Tasks 3 and 4**.

Despite these timelines, there are a few important considerations. For example, depending on the complexity of the design and testing, this program could be completed on a much-accelerated timeline. A faster execution is encouraged as it delivers value to the NSTC members more quickly. Also, programs working entirely on the Transition track may have a much simpler timeline.

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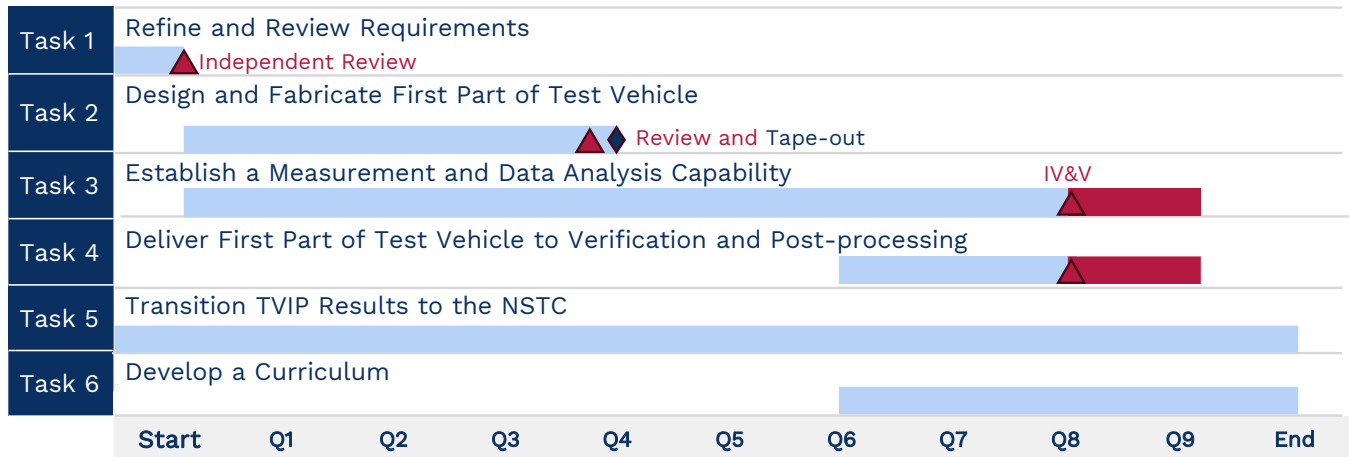


Figure 3: Notional task GANTT Chart. Teams should provide a timeline suitable for their test vehicle timeline. Faster is encouraged.

Natcast and its technical reviewers will evaluate each team’s performance upon completion of each task. Natcast may terminate the award agreement should the results not meet the program objectives.

Teaming is highly encouraged and Natcast foresees a diverse group of performers forming cohesive teams capable of meeting the program's objectives. Teams may include unfunded collaborators. Please note that the team should contain members able to utilize and verify that the produced vehicles meet the expected TRL specifications. Proposers should consult Section 3 for eligibility.

1.6 Schedule and Milestones

The thirty-month TVIP program planned schedule is shown in Figure 4. In addition to the kickoff meeting there will be several in-person reviews. Subcontracting performers are expected to attend in person and should budget accordingly. The in-person reviews, to be held at the performer site or another location of Natcast’s choosing, are scheduled for the end of Months 3, 6, 12, 18 and 24, and the final review will be held during Month 30. There will be monthly update meetings for all other months.

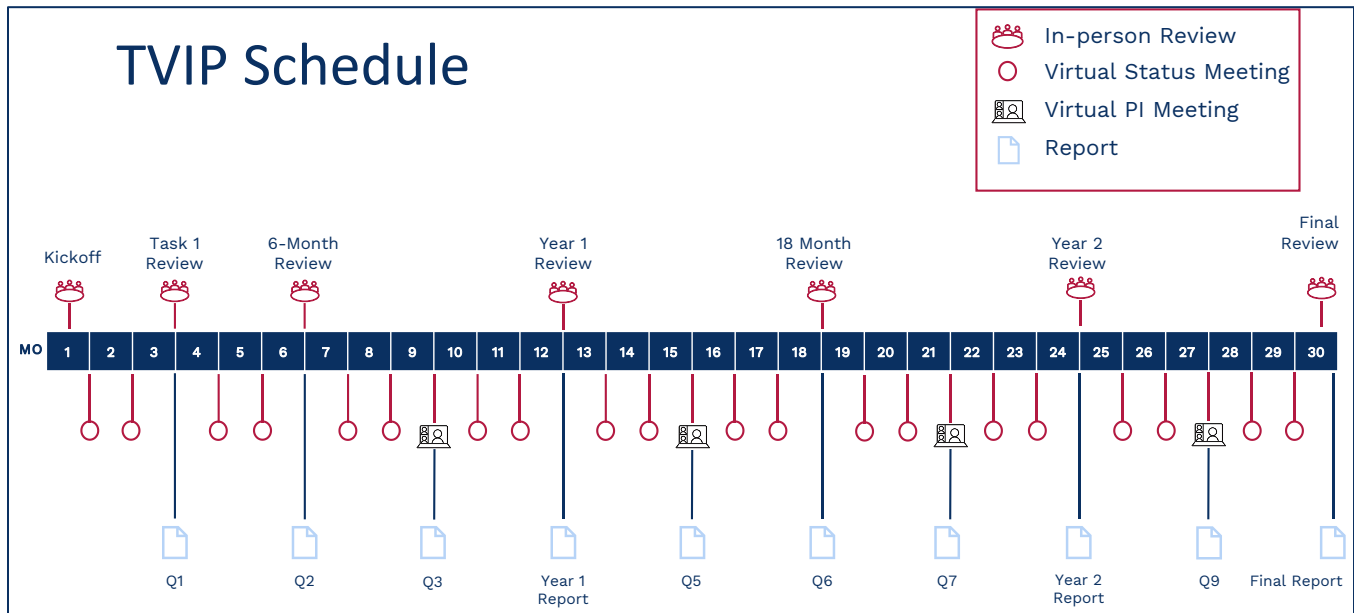


Figure 4: TVIP Schedule and Milestones

An April 2025 project start date is targeted. The program kickoff, interim review, final review, and monthly status meetings will provide opportunities to interact with Natcast regarding the scope of work, specifics of the technical approaches, and any technical or programmatic items of concern. In addition, one or more technical workshops open to all performers may be held during the program in which performers may provide further insights on future technical paths and challenges that must be addressed. Performer teams are encouraged to share and interact with other teams. Monthly progress teleconferences will be scheduled with the Natcast team to review technical progress and identify risks to completing the tasks outlined in the Statement of Work (SOW).

1.7 Deliverables

The list of deliverables is shown in Table 1. These include all presentation material from all review and status meetings; kickoff, quarterly, task, annual and final written reports; and schematic and layout of all designs for all the designed circuits. Please note that the availability or non-availability of deliverables to Natcast and NSTC members will be governed pursuant to the proposer’s Intellectual Property Management Plan as well as the NSTC Transition Plan. Section 2.5.1 outlines more detailed legal and data sharing requirements as well as exclusions.

| <i>Key Technical Deliverable</i> | <i>Comments</i> |
|--|---|
| <i>Reports</i> | <i>Quarterly Reports Annual Reports Final Report</i> |
| <i>Presentation Material</i> | <i>From all reviews and status meetings</i> |
| <i>EDA Databases and design files</i> | <i>List of finalized requirements All design files Design documentation</i> |
| <i>Measurement workflow</i> | <i>Documentation and source code</i> |
| <i>Data analysis/TCAD workflow</i> | <i>Documentation and source code</i> |
| <i>Overall Test Vehicle Manual</i> | <i>A complete guide to use the test vehicle including quantitative metrics for incoming and outgoing wafers, materials/process compatibility, dedicated process modules for test vehicle processing</i> |
| <i>Developed Curriculum</i> | <i>All relevant course material and documentation for use by NSTC membership.</i> |
| <i>Mask Sets</i> | <i>The mask sets produced by the program</i> |
| <i>Datasets from post-processing and verification team</i> | <i>Measurements and results from testing of the vehicles</i> |
| <i>NSTC Transition Plan</i> | <i>Establishing a process and pathway for NSTC members to gain access to the test vehicles</i> |

Table 1: Program Deliverables

In connection with the reporting obligations described in Section 6.3, the performer will provide to Natcast quarterly written reports that include a description of newly developed IP, including patentable inventions, software, and research results, as well as any utilization activities of such IP.

1.8 Metrics

A successful demonstration of multi-TRL Test Vehicles will reduce costs and time when moving a new process, material, or device to a higher TRL. In addition to furthering progress

towards the goals of the TVIP program, a successful project will demonstrate advancement by meeting or exceeding specified metrics. For the purposes of this program, the metrics are primarily evaluated against the “threshold”, “goal,” and “stretch” targets listed below.

Success metrics for the TVIP program are divided into four key areas:

- **Technology Metrics** – identifying industrially relevant metrics within the key technology vertical and demonstrating that the developed test vehicles enable these metrics. Achieving or demonstrating high performance for the underlying technology is key to exceeding the target metrics.
- **Data Metrics** – demonstrating that the test vehicles have a comprehensive and well-defined measurement process so that a user could measure the vehicles themselves or use commercial vendors to extract a well-structured dataset. In addition, demonstrating that by using well-structured datasets a user can rapidly and easily generate an accurate analysis after loading relevant metadata (i.e., data that cannot be directly measured from the vehicles, such as how it was processed).
- **Accessibility** – demonstrating that the developed solution, composed of one or more test vehicles, can be used across all the relevant TRLs so that diverse constituencies can use the test vehicles to advance to commercialization their new material, process, or device.
- **Documentation** – core documents should enable the use of the test vehicle post program, these documents should include:
 - a test vehicle manual which should fully enable researchers and developers across TRLs to be able to use the vehicle and avoid common pitfalls.
 - quantitative wafer incoming/outgoing criteria for major facilities as part of the test vehicle manual
 - quantitative material/process compatibility criteria for introducing new technology into a production environment as part of the test vehicle manual
 - coursework demonstrating the incorporation of the TVIP learning into curriculum.

Target metrics are shown in Table 2. Strong proposals should demonstrate a team’s plans and capabilities to meet or exceed the metrics stated below. Proposals may also describe additional metrics and data by which the team will demonstrate success and achievement of the goals of the TVIP program.

It is important to note that certain metrics may conflict with one another. Referring to the table below, a stretch target for a technology metric may contradict an accessibility metric,

for example, high density arrays are intrinsically not compatible with contact lithography. Proposers should either balance the diverse needs of different stakeholders or generate enough solutions within a design to accommodate the different needs.

It is expected that Generation Track proposals should be able to meet all or most of the Targets. However, in some cases, a target may not be appropriate as stated, in which case, it will either not be applied, or the IV&V team will evaluate during **Task 1** an alternative set of more appropriate targets for the specified vehicle.

Transition Track proposals, unless they include elements to adapt their proposed IP to additional TRLs, are not expected to meet all of the targets and the proposer should specify which of the targets they intend to meet.

| | Targets | | |
|---|---|--|---|
| Technology Metrics | Threshold | Goal | Stretch |
| EUV Process | Dots and lines, Relevant film stacks | Memory and Logic Relevant Structures | Next generation or exotic geometry, planarized multi- material, multi-layer templates |
| FEOL/MEOL | Contact Resistance and Material/Process Compatibility, relevant process geometry | DC and LF noise Measurements | HF AC measurements, Array Macros, reliability measurements |
| CMOS+X/BEOL | Material/Process Compatibility, contact Resistance, relevant process geometry | Small Array Macros, narrow technology range | Large Array Macros, multi-technology, on- chip AC measurements |
| Data Metrics | Threshold | Goal | Stretch |
| Preparation of measurement capability | Pre-canned documentation covering multi-modal characterization from commercial vendor | Partial automation of primary measurement, PCB test harness | Fully automated multi- modal measurements |
| Preparation of automated data analysis workflow | Interactive Software workbench with test vehicle preprogrammed | Semi-automatic script driven analysis of raw data from measurements | Automatic, cloud- based platform fitting and benchmarking data |

| Accessibility Metrics | Threshold | Goal | Stretch |
|-----------------------------|---|--|---|
| TRL 3-4 | 100 mm wafer level processing, compatibility with e-beam lithography, | Coupon-level processing, compatibility with laser writer | Compatibility with contact lithography |
| TRL 5-6 | Appropriate alignment marks, 300 or 200 mm wafer processing, e-beam lithography | DUV lithography, 100 mm wafer processing, Partial Material compatibility Criterion | Full material/process compatibility criterion |
| TRL 7 | Fully Functional in source facility. Established material/process compatibility criterion | Documented criterion for wafer incoming/outgoing to facility | BEOL processing in a 2 nd 300 mm research facility and able to meet digital logic timing |
| Documentation | Threshold | Goal | Stretch |
| Overall Test Vehicle Manual | Schematic diagrams, background information | Guide to the use of the Vehicle(s) across TRL levels. | Comprehensive guidance from verification teams. Full materials/process compatibility evaluation criterion to advance TRLs |
| Development of Curriculum | Materials developed | Active class or training | Students Taught using TRL 3-4 vehicle in an academic cleanroom |

Table 2: Metrics for the program. Depending on the test vehicle embodiment, not all metrics will map directly onto the vehicle.

2. Award Information

2.1 General Award Information

Natcast anticipates granting 4-12 awards not to exceed a total program budget for the awards of up to \$55M. The number of awards will depend on the proposed budgets and the

availability of funds. Awards will be made to proposers whose proposals best address all evaluation criteria and selection factors.

2.2 Terms and Conditions

By submitting a proposal, proposers affirm that they have read, understood, and agreed to the terms and conditions contained in the CFP.

Natcast is not obligated to make an award, or award the full amount of available funds, as a result of the CFP process or the receipt of proposals in response to this CFP. Natcast's internal CFP process is flexible and may include, for example, requesting additional documentation from proposers, modifying the proposed budgets or scope of work for individual awards, or conducting further discussions with proposers as a part of the process.

Funds will only be made available after entering into a binding award agreement. Natcast may remove proposers from award consideration if the parties fail to reach agreement on award terms within a reasonable time or the proposer fails to provide requested additional information in a timely manner.

As a part of the CFP process, proposals and related information submitted under the CFP may be used, excerpted, copied, reproduced, and/or distributed to Natcast employees, contractors, consultants, and external reviewers as well as the Department of Commerce or other Federal agencies and their contractors or consultants for the purposes of conducting the competition under this CFP. Persons requiring access will be subject to appropriate non-disclosure and conflict of interest requirements.

Any parts of a proposal shared with Federal agencies may be subject to requests under the Freedom of Information Act (5 U.S.C. § 552). Proposers are encouraged to mark as confidential any part of a proposal they believe is confidential, such as trade secrets or privileged or confidential commercial or financial information.

By submitting a proposal in response to this CFP, proposers represent and warrant that they have the authority to submit a proposal and grant the rights set forth in the CFP on behalf of their organization.

2.3 Fundamental Research

Proposers are required to identify and provide an explanation for whether the proposed research is Fundamental Research or non-Fundamental Research. 'Fundamental research'

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

Natcast reserves the right to make a final determination and may impose award terms and conditions based on the distinction. In particular, any publication based non-fundamental research shall be subject to a pre-publication review.

Proposers should also be aware that the content of a Research Security Plan may depend in part on whether the proposal concerns fundamental or non-fundamental research.

2.4 Research Security

2.4.1 Research Security Review and Risk Determination

Proposers are required to undergo a Research Security Review by NIST in order to be considered for award. The provided Project Narrative Template details the information that proposers must supply for this review, which comprises a brief summary of proposer's current capabilities related to Research Security as well as resumes/CVs and current and pending support forms for all covered individuals. The resulting research security risk determination may be used as a selection factor. Furthermore, Natcast may require that applicants mitigate identified risks as an aspect of award negotiation.

Proposers must provide (as a Project Narrative appendix as specified in Appendix A) a brief summary of proposer's current capabilities related to Research Security that addresses cybersecurity, foreign travel, research security training, and export control to protect against adversarial exfiltration. Each proposer also must attest that, if preliminarily selected for an award, the proposer has the capacity and intends to develop a Research Security Plan prior to receipt of the award demonstrating that NSTC-funded research and associated data products will be protected.

2.4.2 Research Security Plans

As an aspect of award negotiation, selected proposers may be asked to improve their research security practices or plans. It is essential that proposers be prepared to strengthen their research security protocols as part of the award process and/or over the course of the period of performance.

If and when selected for award negotiation, proposers must submit a detailed description of their current Research Security Plan or (if none) describe a plan to protect Natcast-funded research and associated data products; this plan must include an implementation timeline. The description must identify a member of proposer’s leadership team to serve as the point of contact responsible for coordinating with Natcast on research security issues. The description must further describe the applicant’s existing or proposed internal processes or procedures to address cybersecurity, foreign talent recruitment programs, conflicts of commitment, conflicts of interest, research security training, and research integrity. The description must also address research security considerations involving subcontractors, if any. Appendix D contains a Research Security Plan questionnaire that will be requested if and when a proposal is selected for award negotiation. Award terms will specify that within ninety (90) days of award, proposers must show progress on implementing the Plan as applicable.

2.5 Intellectual Property and Data Rights

2.5.1 Award Agreement IP terms

The award agreement will include terms and conditions related to intellectual property and data. Certain of these terms and conditions are specifically required by Natcast’s obligations to the Department of Commerce; others are intended to fulfill the NSTC mission of furthering research and engineering throughout the semiconductor ecosystem. This program is the second that Natcast is funding and coincides with the launch of the NSTC and the development of policies to be adopted by the NSTC including with respect to intellectual property. The terms below apply only to this program; future programs may be accompanied by different terms with respect to IP.

The following commitments will be required of all performers. A performer is responsible for ensuring each member of its team and their respective affiliated organizations comply with the IP terms of the award agreement.

- **Ownership of IP:** The performer or, as applicable, the Project team member responsible for development, will own all intellectual property and data developed by such performer or team member under the Project.
- **Government License:** The U.S. Government will have a nonexclusive, nontransferable, royalty-free, fully paid-up, worldwide, perpetual license to practice all inventions that are or may be patentable developed by the performer, using government funds, during the TVIP program, for research and non-commercial purposes.

- **Government Data Rights:** The U.S. Government will have the right to use, duplicate, or disclose all information contained in the performer’s quarterly reports, in whole or in part, and in any manner, for U.S. Government purposes, and to have or permit others to do so for U.S. Government purposes, except to the extent such reports contain proprietary information of the performer.
- **Domestic Control Restrictions:** The performer will comply with domestic control requirements adopted by Natcast pursuant to the Department of Commerce’s policies under the CHIPS Act, 15 U.S.C. § 4656(g), including: (a) the owner of the inventions developed during the TVIP program that are or may be patentable under U.S. law must be a “domestic entity”—meaning, either a state, local or tribal government or a US entity with its principal place of business in the US; (b) that domestic entity—and any successor in interest—may not sell, transfer, or assign ownership of any developed inventions that are or may be patentable under U.S. law to a foreign adversary (“foreign adversary” includes any “foreign entity of concern” and “foreign country of concern” as defined in 15 C.F.R. § 231.102, § 231.104); (c) that domestic entity may not grant a license to a foreign adversary with some limited exceptions; and (d) that domestic entity may only assign ownership of the developed inventions that are or may be patentable under U.S. law to a foreign entity (that is not a foreign adversary) after the expiration of a specified period of years; the specific period of years will be determined prior to award. While a uniform term of years, and certain disclosure requirements, will be included in all award agreements, performers will have an opportunity to discuss the term of years prior to award.

The following IP commitments are preferred, but Proposers are welcome to propose alternative terms that align with the TVIP program goals. The terms and conditions agreed upon between the Performers and Natcast will be included in the award agreement.

- **Rights to Use Deliverables:** The performer will grant to Natcast the rights necessary to achieve the goals of the TVIP program. Those goals are as described in this CFP and include (i) the establishment, and operation by or for Natcast, of a Test Vehicle Repository, which includes test vehicles (e.g., test chips and wafers) and related high-level designs, mask sets, documentation, workflows, datasets and other materials that will be available for use by or for Natcast and NSTC members, both during and after completion of the TVIP program, (ii) the manufacture, and supply by or for Natcast and NSTC members, of test vehicles from the repository, and (iii) the provision and licensing of materials from such repository to Natcast and NSTC

members. The rights granted will include a non-exclusive license (with the right to sublicense to NSTC members) to use the Deliverables, and to practice the Related IP Rights, without the obligation to make additional payments other than the milestone payments set forth in the award agreement or as otherwise agreed to by the parties in the award agreement.

- Natcast will consider exceptions to these usage rights if specifically requested in the performer’s written proposal responding to this CFP. For example, Natcast understands that if the performer proposes to provide a commercially available software product as part of the Deliverables, it may want to exclude that product from the proposer’s obligation to make it available to NSTC members without additional payment.
- Table 4, set forth below, includes the preferred IP rights that Natcast desires from performers to achieve the goals of the TVIP Program. The preferred IP rights for exemplary types of Deliverables are described below:

| Type of Deliverable | Preferred IP Terms |
|--|---|
| Reports, presentation materials, test vehicle manuals, developed curriculum and other content or documentation | Natcast and NSTC members should be able to use the reports, presentation materials, test vehicle manuals, developed curriculum and other content or documentation. |
| EDA design files | <p>Designs should be made available for the purpose of fabricating test vehicles for Natcast and NSTC members. Natcast is open to doing this in a way where Natcast/NSTC members (other than the companies they select to fabricate the test vehicles) do not have access to the underlying files.</p> <p>Licensing fees: The performer may propose commercial terms that it may charge Natcast to use the designs to have test vehicles fabricated for Natcast and NSTC members after the TVIP program is over. The reasonableness of the commercial terms will be a criterion in evaluating the proposal.</p> |

| | |
|--|---|
| <p>Interfaces/workflows (including measurement, TCAD, data analyses)</p> | <p>Natcast and NSTC members should be able to use the interfaces, workflows and other deliverables made specifically for, and under, the TVIP program.</p> |
| <p>Mask Sets</p> | <p>Natcast should be able to use the mask sets to fabricate test vehicles for Natcast and NSTC members, both during and after the TVIP program.</p> <p>The performer may propose commercial terms that it may charge Natcast for fabricating test vehicles using the mask sets for Natcast and NSTC members after the TVIP program is over. Additionally, the proposal should include minimum manufacturing quantities or conditions that will remain in effect after the program concludes to ensure continued manufacturing support beyond the program's duration. The reasonableness of these terms will be a criterion in evaluating a proposal.</p> <p>It is preferred that performers transfer ownership of new mask sets to Natcast. Natcast is open to other ownership arrangements, as long as the mask sets remain available, after the program is over, to fabricate test vehicles for Natcast and NSTC members.</p> |
| <p>Datasets and Test Results</p> | <p>Natcast and NSTC members should be able to use the datasets and test results generated during the TVIP program.</p> <p>The performer is required to provide a useful dataset to Natcast, but may, subject to this requirement and with Natcast's approval, remove particular data that will reveal sensitive, proprietary information of the performer.</p> |
| <p>NSTC Transition Plan</p> | <p>Natcast should be able to use the NSTC transition plan.</p> |

Table 4: IP Terms of Deliverables

2.5.3 Intellectual Property Management Plan

Each proposer must submit an Intellectual Property Management Plan, in which the proposer should clearly identify (1) any Background IP, incorporated into, embodied in or otherwise used to complete the Deliverables, that is not being made available to Natcast

and NSTC members on a non-exclusive royalty free basis (2) IP that is expected to be developed in connection with the TVIP program.

It is recommended that in connection with identified Background IP, performer (i) should identify the excluded Background IP (e.g. APIs, pre-existing workflows, recipes, commercially available software and tools) with as much specificity as reasonably possible, describe how the excluded Background IP is used in or relates to the Deliverables, and describe how the requested exclusion for the Background IP could be expected to affect the Deliverables, the usability thereof, and achievement of the goals of the TVIP program, and (ii) should (a) specify the pricing, licensing and other commercial terms under which the performer would license the otherwise excluded Background IP to Natcast and NSTC members after the TVIP Program is over or (b) state that it is unwilling to make available or license the Background IP. The reasonableness of the commercial terms for the Background IP will be a criterion in evaluating the proposal.

Additionally, the Intellectual Property Management Plan should identify any encumbrances on the Deliverables or Related IP (e.g., third party IP) that could affect the obligations of the performer or the rights of Natcast and NSTC members

The Intellectual Property Management Plan may also identify any restrictions on use of the Deliverables, such as restrictions on commercial use by Natcast or NSTC members.

Pursuant to 15 U.S.C. § 4656(g), the proposer should describe how the proposed management and ownership of inventions that are or may be patentable will ensure domestic control of such CHIPS funded intellectual property, including to protect such intellectual property from foreign adversaries.

Section 2.5.1 describes the minimum desired IP rights for the TVIP program, and the Intellectual Property Management Plan should affirm the proposer's commitment to the minimum desired IP terms. Additionally, the proposer should specify its commitment to any preferred terms (as identified in Table 4) or propose any alternative terms. Terms that align with goals of the TVIP program and provide potential benefits to Natcast and NSTC members, as described in Section 5.1, will be considered as an evaluation factor.

2.5.4 Definitions for IP and Data Rights Terms

For purposes of this Section 2.5, the following terms (whether or not capitalized) have the following respective meanings:

“Background IP” means any pre-existing IP developed independently of the TVIP program.

“Deliverables” means materials and information provided, or required under the award agreement to be provided, to Natcast or NSTC members in connection with the TVIP program.

“IP” and “intellectual property” means all intellectual property, intellectual property rights and other proprietary rights, including copyrights; software, written materials and other works of authorship; other rights in software; data, databases and rights in data and databases; mask works and mask work rights; patents, patent applications and rights with respect to inventions; trade secrets and other information and ideas not generally known to the public; and methods, processes, algorithms and other subject matter of intellectual property or other proprietary rights. “IP” and “intellectual property” do not include trademarks and related rights unless otherwise specified. This definition does not apply to references to IP or Intellectual Property under 15 U.S.C. § 4656(g).

“Related IP Rights,” in reference to Deliverables, means IP embodied in or necessary for use of the Deliverables.

“Use,” with respect to Deliverables or IP, means to utilize, reproduce, distribute, disclose, modify, and make and supply products or services using, such Deliverables or IP, and otherwise use such Deliverables and IP. This definition does not apply to references to use by the U.S. Government.

2.6 Domestic Production

To promote a robust, sustainable domestic capacity for semiconductor R&D, prototyping, and production, and pursuant to the CHIPS Act domestic production requirements (15 U.S.C. §4656(g)), CHIPS R&D requires applicants to develop plans to domestically produce intellectual property resulting from CHIPS-funded microelectronics research and development. For the purposes of 15 U.S.C. § 4656(g):

- “intellectual property” means any invention that is or may be patentable under U.S. law.
- “production” includes the manufacture, integration, assembly, testing, and packaging of semiconductors, materials used to manufacture semiconductors, or semiconductor manufacturing equipment developed or improved as a result of CHIPS-funded intellectual property.

For the purpose of this Call for Proposals, only activities relating to creation of tangible assets such as mask sets and wafers, but not intangible assets such as software and designs, are subject to the Department’s domestic production requirements. Applicants

must explain the extent to which they plan to engage in production in the United States of any intellectual property (in the form of tangible assets), as defined for purposes of 15 U.S.C. § 4656(g), developed through this funding opportunity. A proposal’s initial plans to engage in domestic production may be refined over the course of the award and must be updated on at least a yearly basis for the duration of the award. To the extent it is not reasonably “possible” for any Proposers to conduct certain covered “production” activities in the United States (15 U.S.C. § 4656(g)), the Proposers must provide their reasons, relying on the factors described below.

1. The availability or lack of availability of domestic production capabilities, which may consider:
 - a. Planned or previous efforts made to locate, develop, or contract for the production of the CHIPS R&D-funded technology, or relevant similar technologies, in the United States;
 - b. Access to resources and other material inputs required for production;
 - c. The expected additional product development time or cost required to make U.S. production of the CHIPS R&D-funded technology commercially feasible;
2. The relative costs of domestic versus foreign production of the CHIPS R&D-funded technology, at relevant production volumes;
3. Commercial adoption risks and benefits, such as
 - a. Risks to the market acceptance and to the value proposition for the CHIPS-funded technology, resulting from U.S. production;
 - b. Expected commercial, economic, or national security benefits to the United States resulting from distributed production among U.S. and overseas sites;
4. Any other factors that are important to the success of the CHIPS R&D-funded technology.

2.6.1 Domestic Production Plan

Per the guidelines in Section 2.6, applicants must explain the extent to which applicants plan to engage in production within the United States of any intellectual property (in the form of tangible assets) developed through this funding opportunity (e.g., including but not limited to the mask sets and test wafers).

For example, a Proposer may anticipate producing mask sets and wafers that satisfy the definition of “intellectual property.” In that case, the Proposer must explain, at a minimum, whether and to what extent it plans to produce the mask sets and wafers in the United

States. For instance, if the Proposer plans to produce both the mask sets and the wafers in the United States, it should explain, if it is known at the time, where it intends to produce those items (i.e., in a particular city and state in the United States), and, if it will be produced through the use of any particular vendor.

If, however, the Proposer intends to produce either the mask sets or the wafers outside the United States, the Proposer, if known, must provide the same information (i.e., particular city and country in which the intellectual property would be produced and any particular vendor that would be used) and, in addition, explain why it cannot produce in the United States using the factors listed in Section 2.6.

3. Eligibility Information

The recipient of an Award must be an NSTC Member at the time of Award.

NSTC Members may not be foreign entities of concern or foreign countries of concern, as those terms are defined in 15 C.F.R. 231.104 and 231.102, respectively. Individuals and unincorporated sole proprietors are not eligible to receive funding or for NSTC membership. Moreover, as also required by this CFP, recipients must undergo a Research Security Review (see 2.3.1) and be prepared to implement a Research Security Plan (see 2.3.2).

A lead applicant must be a domestic entity to be eligible for an award. A domestic entity is one that is incorporated within the United States (including U.S. territories) and with its principal place of business in the United States (including U.S. territories). Additional information on participation by foreign entities can be found in Section 3.5 “Foreign Collaboration and Overseas Activities. Additional information about NSTC Membership and the process for becoming a member will be available in the coming months. The NSTC expects to make NSTC Membership terms and fees sufficiently accessible for all expected applicants.

3.1 Federal Entities

Federal Entities (e.g., Federal departments and agencies, military services educational institutions, etc.) are eligible to participate in funding opportunities as team members or contractors, to the extent allowed by law and subject to applicable direct competition limitations. Federal Entities must clearly demonstrate that the work is not otherwise available from the private sector and provide written documentation citing the specific

statutory authority and contractual authority, if relevant, establishing their ability to receive Federal award funds and compete with industry. Applicants must identify the Federal entity in the Project Plan and provide documentation attached to the required letter of commitment establishing that the Federal entity is able to participate in the proposed work.

Federally Funded Research and Development Centers (FFRDCs) may participate in awards as subrecipients or contractors, to the extent allowed by law, based on the unique and specific needs of the project. Applicants must identify the FFRDC(s) in the Project Plan and provide documentation attached to the required letter of commitment establishing that FFRDC subrecipients and contractors are able to participate in the proposed work, including:

- Documentation demonstrating that the proposed work does not compete with the private sector; and
- Documentation from the FFRDC's sponsoring institution citing the FFRDC's eligibility to participate in competitive Government funding opportunities; the FFRDC's compliance with the sponsor agreement; and confirmation from the sponsoring agency that they can receive Federal funds from Natcast.

3.2 Eligible Use of Funds

Eligible uses may include, but not be limited to, basic and applied research, demonstration, prototyping, preparation of commercial viability and domestic production information, industry stakeholder engagement, design work, information collection, acquisition of software or hardware, manufacturing costs, associated program travel, data analysis, audit costs.

Use of funds for travel costs must be consistent with the following guidelines. Permissible Costs include necessary and reasonable costs for travel to perform the scope outlined in the projects. For common carrier transportation costs, performer shall agree that it will travel by a direct route or on an uninterrupted basis (i.e., travel will not be interrupted for personal convenience). In addition, travel will be by coach class, except for instances in which Natcast has provided written approval. Non-coach class travel is expected to be rare, and the Natcast may utilize the standards in 41 C.F.R. § 301-10.103 to determine whether, in their discretion, to approve other than coach class transportation. For meals and incidental expenses, the per diem rates established by the Federal Travel Regulation are to be utilized. For lodging, performers should plan to book reasonable but not extravagant lodging accommodations for employees in travel status. Performers should make use of government

rates whenever possible; otherwise, corporate rates or other discounts should be obtained whenever possible. For air travel, performer shall use U.S.-flag air carriers to the extent the carriers provide those services, consistent with the Fly America Act at 49 U.S.C. § 40118.

Applicants may also propose to expend limited funds to protect innovations or content developed under the funding opportunity, such as fees for patent or copyright protection or to enhance research security.

3.3 Organizational Conflict of Interest

Proposers are asked to identify any potential organizational conflicts of interest that may arise in the context of this CFP, and (if applicable) potential strategies that Natcast should consider in mitigating those conflicts.

3.4 Cost Sharing

Cost sharing is encouraged but not required for this effort. In that light it is neither an evaluation nor selection criterion.

3.5 Foreign Collaboration and Overseas Activities

Foreign entities (e.g., for profit companies, educational institutions, and other non-profits) and foreign individuals can participate in research funded by Natcast R&D on an unfunded basis, subject to certain limitations such as a research security review, to ensure the protection of CHIPS R&D-funded intellectual property from foreign adversaries.

To protect national security and the resiliency of supply chains, however, foreign entities of concern may not receive Natcast R&D funds or participate in NSTC R&D programs. Foreign entities of concern (“FEOCs”) include entities owned by, controlled by, or subject to the jurisdiction or direction of the governments of China, Russia, North Korea, or Iran. Complete definitions of foreign entity of concern and foreign country of concern are found at 15 CFR part 231.

Foreign entities that are not FEOCs may participate, on a funded basis, as members of a project team, as subrecipients or contractors, subject to Natcast approval. The applicant must provide Natcast with a written justification demonstrating that the foreign entity’s involvement is essential to advancing project objectives, such as by offering access to unique facilities, IP, or expertise that is otherwise not readily available in the United States. Natcast will only approve work outside of the United States if it is in the best interest of

CHIPS R&D and the United States, including the domestic economy generally, U.S. national security, U.S. industry, and U.S. manufacturing competitiveness. Natcast's determination regarding the performance of project tasks outside the United States will be based on information provided by the applicant and by other Federal agencies.

A foreign entity is any entity that is not a domestic entity. A domestic entity is one that is incorporated within the United States (including U.S. territories) and with its principal place of business in the United States (including U.S. territories).

4. Proposal and Submission Information

4.1 Proposal and Submission Information

Natcast will follow a five-step process for making the TVIP award:

Step 0: Concept paper submission is a requirement.

Submission of a maximum 5-page concept paper is required for submission of a full proposal. Concept paper submission is a requirement. Recipients will receive feedback encouraging or not encouraging a full proposal within 10 days of submitting a concept paper. Concept papers should list the project's title, proposer's team, principal investigators, team point of contact, and estimated budget. The composition of the team can change between concept paper submission and proposal submission. Concept paper submissions should include a summary of the proposed technical agenda and will be evaluated against the first two criteria laid out in section 5.1.

Step 1: Full Proposal submission

Step 2: Full Proposal evaluation

Step 3: Research Security Review and Research Security Plan

Step 4: Negotiation and Award

The concept paper (Step 0) and the full proposal must be uploaded to a secure web site <https://natcast.secure-platform.com/rnd>. It is also possible to navigate to this site from the TVIP home page, <https://natcast.org/research-and-development/tvip>.

4.2 Dates

Key dates are given below. Please note: **all submissions are due by 5:00pm EDT on the specified date.**

| Activity/Event | Date |
|-----------------------------------|-------------------|
| TVP Informational Webinar | 8/20/2024 |
| TVIP CFP Released | 8/28/2024 |
| TVIP Proposers' Day | 9/10/2024 |
| TVIP Concept Paper Due (Required) | 09/18/2024 |
| Question Submission Deadline | 10/11/2024 |
| Proposals Due | 10/21/2024 |
| Target Awards Announced | Feb-25 |
| Target Project Start | Apr-25 |

4.3 Proposal form and Content

Proposals are required to adhere to a Project Narrative structure. Page limits and policy requirements are explained in the template.

Proposals must contain the following:

Project Narrative (due 10/21/2024)

See Appendix A below for detailed requirements and suggestions.

- Cover Sheet
- Executive Summary
- Goals and Impact
- Management Plan
- Technical Plan
- Intellectual Property Rights Management Plan
- Appendices
 - Table of Abbreviations and Acronyms
 - Bibliographic List of References
 - Table of Funded Participants and Unfunded Collaborators

- Statement of Work (SOW)
- Budget Volume (*Optional prose appendix, to be supplemented by an excel-format Budget Workbook uploaded separately*).
- Domestic Production Plan
- Research Security Capabilities
- Resumes/CVs
- Current and Pending Support Forms
- Letters of Commitment
- Letters of Support from Potential Test Vehicle Users

Budget Workbook (due 10/21/2024)

The budget workbook is an Excel-format document, uploaded separately from the Project Narrative. Budget template will be made available for the convenience of proposers at the TVIP home page <https://natcast.org/research-and-development/tvip>.

For full instructions and requirements of the Executive Summary, Project Narrative contents, and Budget Volume contents, see the annotated outline in the below Appendix A.

4.4 Teaming

It is anticipated that this effort will be led by teams including combinations of university researchers, start-ups, commercial and defense companies; semiconductor foundries; established and start-up EDA tool companies; and US government funded labs. Teams may include unfunded collaborators. Please note that the team should contain members able to utilize and verify that the produced vehicles meet the expected TRL specifications.

Teams should be comprised of one lead proposer (the “Performer”) with funded team members who would become sub-awardees and/or unfunded collaborators. Funded and unfunded collaborators must meet eligibility requirements and should submit a teaming letter with the project proposal or white paper. Full proposals should include a sub-awardee budget in addition to letters of commitment.

4.5 Frequently asked questions

Proposers can submit questions via email prior to September 15th by submitting questions to TVIP@natcast.org. Abstracted answers will be shared publicly via FAQ posted at <https://natcast.org/research-and-development/tvip>.

5. Proposal Review Information

5.1 Evaluation Criteria

Proposals to this solicitation will be evaluated according to the following criteria, listed in priority order:

- **Utility and Benefit to NSTC membership:** This criterion addresses the potential utility and benefits of the proposed test vehicles deliverables to Natcast and the NSTC membership. Some illustrative examples that Reviewers will consider, are included below:
 - The overall accessibility of the test vehicle (through multiple manufacturing pitches, form factors, and alignment mark) and number of potential users interested in the test vehicle
 - The extent to which Proposals offer low-cost, reasonable manufacturing terms, as well as volume commitments, to manufacture test wafers embodying the test vehicles for Natcast and NSTC members.
 - The reasonableness of the terms for Natcast and NSTC members to gain access to the Test Vehicle IP.
 - The speed at which the potential test vehicle users can expect to both produce and turn around new result compared to if they did not have access to the test vehicle
 - The number of technologies that are applicable for a given set of proposed test vehicles
 - The degree to which the test vehicle improves the quality of data generated using the test vehicle compared to if users had to create their own platforms

- **Overall Scientific and Technical Merit:** This criterion addresses the quality, innovativeness, and feasibility of the project proposal and the potential for meeting the objectives of the funding opportunity. Reviewers will consider the extent to which:
 - The proposed activities are innovative, original, or potentially transformative;
 - The extent to which the proposed test vehicles could lead to a fundamental advance in science which would otherwise not occur had test vehicle users not had access to them due to a lack of overall availability of test vehicles to the audience gaining access to them

- The proposal demonstrates knowledge of the current state of the art in relevant fields and the feasibility of the proposed technologies to be advanced, including gaps, constraints, and significant challenges that must be addressed; and
 - The plans for Project-Level Technical Targets represent a significant advance relative to the state of the art globally in the field of technology development, exploration and transfer
 - The proposed plans rely on the use of proven and reliable processes or test vehicles which have been shown to work in the past but had not otherwise been generally accessible to a broad user base like the NSTC membership.
 - The extent to which the proposal is comprehensive in its integration of data acquisition and analysis with the test vehicle
- **Relevance to economic and national security:** This criterion addresses relevance of the proposal to enhancing U.S. economic or national security competitiveness. Reviewers will consider the extent to which the project is likely to:
 - Advance domestic semiconductor development capabilities;
 - Generate substantial economic benefits to the Nation that extend beyond the direct return to participants in the program; and
 - Support the development of semiconductors necessary to U.S. national security systems, other government systems, or critical infrastructure.
 - Impact or are useful to national security related government programs such as the DoD Microelectronic Commons
- **Transition and Impact Strategy:** This criterion addresses the project's potential for supporting the commercialization and domestic production of funded semiconductor innovations, as well as beneficial impacts to workforce development and the broader domestic research, development, and innovation ecosystem. Reviewers will consider the extent to which the proposal provides:
 - A test vehicle capability which impacts an important area of fundamental research for the semiconductor industry.
 - The potential for the test vehicle to successfully move a subject technology from basic research into mass production
 - The potential for which the proposed test vehicles, can be used by a broad user base and such use can generate useful datasets.

- The relevance of the potential test vehicles for other CHIPS Research and Development Programs especially the CHIPS Manufacturing USA, the CHIPS Metrology Program, and the National Advanced Packaging Manufacturing program
 - Outlines an education and workforce development plan appropriate to developing a workforce relevant to domestic semiconductor manufacturing capabilities.
 - The evaluation may also consider the applicant’s history of transitioning (or plans to transition) technologies to foreign governments or to companies that are foreign owned, controlled, or influenced.
- **Project Management:** This criterion addresses the degree to which proposers demonstrate that they have the appropriate personnel and access to required equipment and facilities. Reviewers will consider the extent to which the proposal:
 - Identifies key staff, leadership, and technical experts with qualifications and experience appropriate to the proposed work, including prior experience and results in efforts similar in nature, purpose, or scope of proposed activities.
 - **Cost and Schedule Realism:** This criterion addresses the cost and scheduling of the proposal. Reviewers will consider the extent to which the proposal costs and schedule are both:
 - Necessary to achieve the project objectives.
 - Sufficient to achieve the project objectives.

5.2 Selection Criteria

Natcast will select a portfolio of proposals based on a broad range of criteria including:

- **Merit Review.** Results of the merit reviewers’ evaluations, including narrative evaluations (if applicable), and the Reviewers’ adjectival ratings (if applicable).
- **Relevance to Program and Mission.** Alignment with the objectives of the funding opportunity as well as the objectives and priorities of NSTC and the mission, goals, and priorities of the NSTC R&D program, which may include considerations related to research security, domestic production, and domestic control of intellectual property. This could also include the relevance of the proposed test vehicles for use with or introduction into future NSTC facilities.
- **Funding.** The availability of funding.

- **Diversity of Projects and Participants.** The degree to which the selected portfolio of proposed teams and project provides for a diversity of proposed project topics or approaches, regional diversity of participants, and institutional diversity (including small and medium enterprises, universities, nonprofit research organizations, etc.) in the overall NSTC projects portfolio.
- **Funding duplication.** Selection will strive to avoid funding duplicative projects
- **Benefit to NSTC membership.** The extent to which IP plans and other factors benefit the NSTC membership, as described in Section 5.1.
- **Establishment of a test vehicle portfolio.** The selection of projects will ensure that NSTC members have access to diverse test vehicles that are both appropriate for the specific technology readiness level and relevant to the most important technology areas for the members. To achieve this, individual proposals may be downsized during the selection process to create a comprehensive and non-overlapping portfolio that spans all technology readiness levels and multiple technology areas. Additionally, projects capable of providing test vehicles more quickly may receive preferential selection to expedite the establishment of the portfolio. For generation track IP, programs must align with the proposed technology focus areas.
- **Research Security Risk.** Natcast may consider the results of a Research Security Review in its selection.

5.3 Review of Proposals

The review process involves evaluation of each conforming and eligible proposal on its individual merits, followed by a selection process that considers a range of broader criteria that are comparative and/or additive of the merit evaluation as Natcast determines which set of proposals best meets the program objectives.

Natcast may, at its discretion, review a substantially complete proposal if any gaps in information can be rectified easily during the review or award process.

6. Award Administration Information

6.1 Notification of Submission Status

Natcast intends to publicly announce awards no later than thirty (30) days after all awards under this CFP are executed. Announcements may occur earlier, such as once award negotiations have sufficiently progressed that all material terms are agreed to and both

parties give consent to announce the Award, provided that such announcements reflect that a final, binding Award has not yet been made.

Proposers will be notified by email if and when a determination has been made to enter award negotiations.

Unsuccessful proposers will also be notified by email and may be offered the opportunity to receive a debriefing after the funding opportunity is officially closed. Applicants must request within ten (10) business days of the email notification to receive a debrief from Natcast. Natcast will then work with the unsuccessful applicant in arranging a date and time of the debrief.

6.2 Policy Requirements

6.2.1 Documentation Retention

Performers must keep and retain records of all data generated through funded research which includes but is not limited to technical data, specifications, software, and mask works. In addition, performers must keep and retain all financial records, supporting documents, statistical records, and other materials related to the award.

These requirements apply for three (3) years following Natcast's final payment.

6.2.2 Tangible Property

The acquisition of certain tangible personal property, including equipment and supplies, must comply with the requirements of 2 C.F.R. § 200.313 and 314. Performers will also be required to record appropriate notices of record to indicate that personal property has been acquired or improved with federal funds and that use and disposition conditions apply to the property, in accordance with 2 C.F.R. § 200.316. For purposes of this CFP, these requirements apply to tangible personal property (including information technology systems), including equipment and supplies, having a useful life of more than one year and a per-unit acquisition cost which equals or exceeds the lesser of the capitalization level established by the acquiring entity for financial statement purposes, or \$10,000.

Certain tangible assets, specifically any property which may be generally considered “customer owned tooling” (mask sets, measurement equipment, etc.) which are wholly or partially acquired through the use of program funds may, in some cases, be expected to be transferred to Natcast at the end of the program to be managed for the benefit of NSTC

members. For example, ownership of mask sets at commercial foundries may be expected to be transferred to Natcast at the end of the program.

Performers may not use Award funds to acquire real property or to engage in construction.

6.2.3 Accounting Standards

Award agreements will require that Performers maintain proper GAAP accounting of all federal funds provided under the Award, including the use of funds for approved research and development purposes as well as maintain commitment to any cost-sharing, if applicable.

6.3 Reporting

The number and types of reports will be specified in the award agreement but will include at a minimum quarterly technical and financial status reports and a final project report.

- **Technical Reports:** These reports should provide Natcast Program Managers with information on the progress of supported projects and the way funds are being used. Technical reports may request the types of information described in the illustrative Technical Report Template found in Appendix C.
- **Financial Status Reports:** Performers report financial information regarding their award using their standard reporting format or as specified in the award instrument.
- **Final Project Report:** This is the last report of the project and should be written specifically for the most recently completed budget period. It should address progress in all activities of the project in its final year, including any activities intended to address the Broader Impacts criterion that are not intrinsic to the research. Illustrative contents of this report are outlined in Appendix D.
- **Post Project Reports:** After the Project is over performer must comply with recordkeeping and reporting obligations required by Natcast for compliance with 4656(g) and tracking IP.

6.3.1 Meeting and Travel Requirements

Please refer to Section 1.6 for travel expectations. Proposers should anticipate travel costs accordingly.

6.4 Federal Requirements

Awards made under this CFP are made from federal funds Natcast receives under an “other transaction agreement” (OTA) with the Department of Commerce. These funds are not generally subject to the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, 2 C.F.R. Part 200, or the Federal Acquisition Regulation. They are subject to requirements imposed via the OTA. The OTA requires that awards under this CFP include terms addressing the following:

- A prohibition on federal funds going to any foreign entities of concern or foreign countries of concern, as those terms are defined in 15 C.F.R. 231.104 and 231.102, respectively, or to any other entity debarred, suspended or otherwise prohibited from receiving federal funds;
- Compliance with export control laws;
- Compliance with Title VI of the Civil Rights Act, Title IX of the Education Amendments, and other non-discrimination laws that prohibit discrimination on the basis race, color, national origin, handicap, age, religion, veteran status, or sex;
- Maintaining effective internal controls;
- Maintaining a System for Award Management (SAM) and ensuring that it is current, accurate, and complete;
- Providing access to records for examination, audit, investigation, or inspection by Natcast, the Department of Commerce, a third party retained by the Department of Commerce, the Department of Commerce Office of Inspector General, or the Comptroller General. This requirement continues to apply for three (3) years after the final award payment, unless otherwise required by law;
- A certification to the best of its knowledge and belief that no Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on its behalf in connection with the making of an award under this CFP.
- For award funded travel, adherence to the Fly America Act at 49 U.S.C. § 40118, economy class travel 41 C.F.R. § 301-10.103, and GSA per diem and hotel rates (<https://www.gsa.gov/travel/plan-book/per-diem-rates>) as otherwise provided by Natcast.

These requirements and others will be specified in award terms. Performers will be subject to sub-recipient monitoring throughout the life of the award, which will include steps to ensure that performers comply with applicable requirements.

6.5 Payment Terms

The TVIP program plans to operate with fixed-price awards, using the following payment structure:

Initial Payment: Upon signing of the award, an initial payment of 15% of the total award value will be made to the proposer or sub awardee.

Milestone Payments: Payments will be made upon the completion of predefined milestones. These milestones and their associated payments will be clearly defined in the contract or agreement.

Final Payment: A final payment constituting 20% of the total contract value will be made upon the acceptance of the final report by Natcast.

All payments, including milestone and final payments, will be subject to the approval of the designated Program Manager (PM) following Natcast’s approval process flows.

7. Other Information

7.1 Contacts

| Subject Area | Point of Contact |
|---|---|
| Programmatic and Technical Questions: | Brian D. Hoskins Ph.D. Email: TVIP@natcast.org |
| Award management: | Jill Bennett Email: TVIP@natcast.org |
| Technical assistance with award submission: | TVIP Program Staff Email: TVIP@natcast.org |

8. Appendices

8.1 Appendix A: Project Narrative Outline

This outline describes the required structure of a proposal. Instructions are included in italics and may be deleted.

(The Project Narrative for a single proposal must be a maximum of 30 pages, including the cover sheet, executive summary, goals and impact, management plan, technical plan, and Intellectual Property and Rights Management Plan. The page limit does not apply to the appendices in section 8.17. Proposers may include as many test vehicles as they desire in single proposal, but the total length must not exceed 30 pages. Additionally, proposers may submit up to four proposals, as outlined in the Executive Summary of the CFP.)

Proposal Formatting requirements

- *Font: Use one of the following fonts:*
- *Arial (not Arial Narrow) a font size of 10 points or larger;*
- *Times New Roman Calibri, or Aptos, at a font size of 11 points or larger; or*
- *Computer Modern family of fonts at a font size of 11 points or larger.*
- *Line spacing: Single*
- *Margins: One (1) inch top, bottom, left, and right*
- *Page layout: Portrait orientation*
- *Page limit: Project proposals should not exceed 30 pages. Only the Goals and Impact, Management Plan, and Technical Plan sections should count towards the page limit.*
- *Paper size: 8.5" by 11" with 1" margins*
- *Application language: English*
- *Typed document: All applications must be typed*

8.1.1 Cover Sheet

8.1.1.1 Funding opportunity name and reference number (if applicable)

8.1.1.2 Relevant technical areas

8.1.1.3 Name of the applicant

8.1.1.4 Name of the project director(s)/principal investigator(s)

8.1.1.5 Any major subrecipients and contractors

8.1.1.6 Project title

8.1.1.7 Point of Contact for the applicant, to include name, address, telephone number, and business e-mail address

8.1.1.8 Total funds requests and total proposed cost-share (if applicable)

8.1.1.9 Any statement regarding confidentiality, including proprietary or sensitive business information, if applicable

8.1.2 Executive Summary

Proposers should provide a concise summary/abstract of the proposed effort including information around:

8.1.2.1 The name of the proposer(s)

8.1.2.2 The name(s) of other collaborators (if applicable)

8.1.2.3 The application title

8.1.2.4 Project objectives

8.1.2.5 Methods to be employed

8.1.2.6 The potential impact of the proposed project (i.e. benefits, outcomes)

8.1.3 Goals and Impact

Proposers should clearly describe what they are trying to achieve and the difference it will make (qualitatively and quantitatively) if successful. In particular, they should provide a clear problem statement and well-defined project outcomes, explaining how both are relevant to the goals and the objectives of the funding opportunity and contribute to economic and national security, as expressed in the evaluation criteria.

Generation track proposals, even if they contain significant existing IP, should strive to achieve a comprehensive solution spanning TRLs and helping diverse stakeholders.

In the case of transition track proposals, the proposal need not meet the criterion of creating a comprehensive solution spanning all TRL levels, but it is encouraged to consider creating derivative IPs to make the solution more accessible.

8.1.4 Management Plan

Proposers should provide a summary of expertise of the team, including any subcontractors, and key personnel who will be doing the work. A Principal Investigator (PI) for the project must be identified, along with a clear description of the team's organization, including an organization chart that includes, as applicable: the programmatic relationship of team members; the unique capabilities of team members; the task responsibilities of team members, the teaming strategy among the team members; and key personnel with the amount of effort to be expended by each person during each year. Proposers should also provide a detailed plan for coordination, including explicit guidelines for interaction among collaborators/subcontractors of the proposed effort, risk management approaches, and descriptions of any formal teaming agreements that are required to execute the proposed research.

8.1.5 Technical Plan

Proposers should outline and address technical challenges inherent in the approach and possible solutions for overcoming potential problems. This section should provide appropriate measurable milestones (quantitative if possible) at intermediate stages of the proposed research to demonstrate progress, and a plan for achieving the milestones. The technical plan should demonstrate a deep understanding of the technical challenges and present a credible (even if risky) plan to achieve the proposal's stated goal and discuss mitigation of technical risk.

In the construction of the technical agenda, the proposer may broadly outline a general approach consistent across one or more test vehicle embodiments wherever appropriate, however, each test vehicle must be proposed and budgeted independently so that, given the limited availability of funds, it may be possible to down select to individual test vehicle embodiments within a proposal.

As part of their proposal, the team should document how they plan to transition their project results to NSTC within the technical narrative. This plan should include a discussion of the productivity gains for researchers, designers, foundries, and others in the semiconductor ecosystem. Many elements of the plan are expected to overlap with the

proposer's Intellectual Property Management Plan (see section 2.5.2). Additionally, the plan should highlight the benefits and integration of the test vehicles for other key programs, such as the CHIPS Manufacturing USA Institute, the CHIPS Metrology Program, or the DoD Commons. It should address the continued production of test vehicles after the program ends, as well as the ongoing support of the test vehicles if appropriate. Furthermore, the plan should cover the transfer and maintenance of software/scripts and how they can be made available to users, such as through cloud deployment, especially if such workflows depend on existing proprietary software.

8.1.5.1 Fundamental Research Declaration

Proposers should identify which of the proposed research activities, if any, the applicant believes NSTC should consider as fundamental research and the rationale for that determination. For any proposed fundamental research, proposers should identify the involved project team member.

8.1.5.2 Proposed International Collaborations

If an international collaboration is required for the project, proposers must provide a written justification demonstrating:

- that the foreign partner's involvement is essential to advancing program objectives, such as by offering access to unique facilities, IP, or expertise that is otherwise not readily available in the United States; the adequacy of any agreements and protocols between the applicant and foreign partner regarding IP protection and data protection;*
- the partnership does not jeopardize the soundness of the project's proposed pathway to domestic production;*
- as applicable, the foreign partner will comply with any necessary nondisclosure agreements, security regulations, export control laws, audit requirements, and other governing statutes, regulations, and policies;*
- the foreign partner is not based in a foreign country of concern as defined at 15 U.S.C. §4651(7) and implemented by the final rule entitled Preventing the Improper Use of CHIPS Act Funding, 88 FR 65600 (Sept. 25, 2023), codified at 15 C.F.R. §231.104; and 6. the foreign partner agrees to be subject to a national security review by CHIPS R&D AND workforce, which may include a risk assessment of IP leakage, if appropriate.*

8.1.6 Intellectual Property and Rights Management Plan

Please refer to Section 2.5.3.

8.1.7 Appendices

Table of Abbreviations and Acronyms

An alphabetical list of all abbreviations, acronyms, and their meanings.

Bibliographic List of References

A complete bibliographic listing of all references used within the application.

Table of Funded Participants and Unfunded Collaborators

A table that identifies all organizations that will participate in and collaborate with the awarded team, known at the time of the application submission. The table should consist of an alphabetically ordered list, by organization, of all team members, funded and unfunded, including any known contractors.

Statement of Work (SOW)

Include a detailed statement of work that captures and defines all the work management aspects of your project. This should feature a more detailed work breakdown structure aligned with the major tasks outlined in the CFP and should include, but not be limited to, key tasks and activities necessary to achieve the project objectives, research methods and experimental designs to be used, and the expected outputs, such as reports, publications, datasets, software, and prototypes. Include start and end dates for each phase or key activity. The budget volume should align with the work breakdown structure of the SOW.

Budget Volume

Budget Workbook (to be uploaded separately as excel spreadsheet)

It is highly recommended that all applicants' cost proposals/budget requests be submitted using the Natcast approved budget workbook available at <https://natcast.org/research-and-development/tvip>. In preparing the Budget Workbook, applicants must provide a concise narrative explanation to support the budget request, explained in detail below.

Note: *If a performer chooses to propose multiple test vehicles for a given technology focus area, it is recommended to use the "Reference for Test Vehicle" field with a unique identifier in the budget workbook. This will help delineate subtasks for each*

test vehicle, separating out the costs and giving Natcast the ability to choose a subset of test vehicles to align with the complete portfolio of proposed projects.

Budget Narrative and Justification

Justifications for expenditures should be outlined in detail on the “Detailed Budget” tab, far right column marked “Justifications.” All information must align with the amounts being requested for that individual line item and funding levels must be consistent with the project scope and allowable costs.

Direct Labor: *The budget justification for all staff/personnel should include the following: Job title, commitment of effort on the proposed project in terms of average number of hours per week or percentage of time, salary rate, total personnel charges for each identified position on the proposed project, description of the role of the individual on the proposed project and the work to be performed.*

Fringe Benefits: *Fringe benefits for each position should be identified separately from direct labor and based on rates determined by your organizational policy. The items included in the fringe benefit rate (e.g., health insurance, dental, life, FICA, etc.) This should not be charged under another cost category.*

Equipment: *Equipment is defined as an item of property that has an acquisition cost of \$10,000 or more (unless the organization has established lower levels) and an expected service life of more than one year. The budget justification should list each piece of equipment, the cost, and a description of how it will be used and why it is necessary for the successful completion of the proposed project. Please note that any general use equipment (computers, etc.) charged directly to the award should be allocated to the award according to expected usage on the project.*

Travel: *For all travel costs, the budget justification for travel should include the destination; number of people traveling; duration; estimated transportation, lodging and per diem rates; and a description of how the travel is directly related to the proposed project. For travel that is yet to be determined, please provide the best estimates based on prior experience.*

Other Direct Costs: *For costs such as supplies, printing, and publications. This can include fewer common items that do not have a specific heading within the budget template. Please list the item, cost, and the breakdown of the total costs by quantity*

or unit of cost. Include and explanation of the necessity of the cost for the completion of the proposed project.

Contractual (i.e., Contracts or Consultants): Each contract or consultant should be treated as a separate item. Identify the cost (daily rate x period) or fixed fee and describe the services to be provided and the necessity of contract to the successful performance of the proposed project. Contracts are for obtaining goods and services for the use on the project and creating a procurement relationship with the contractor.

Subaward (i.e., subrecipient): Each subaward should be treated as a separate item. Identify the entity, cost, and describe the scope of work to be provided by the recipient and the necessity of the subaward to the successful performance of the proposed project. A subaward is for the purpose of carrying out a portion of an Award and creates a Federal financial assistance relationship with the subrecipient.

Indirect/Overhead Rates: Commonly referred to as F&A, Overhead, Indirect Costs (IDC), are defined as costs incurred by the applicant organization that cannot otherwise be directly assigned or attributed to a specific project. The justification should include a cost calculation that reflects the applicable indirect cost rate.

Proposed Milestone Payments

Applicants must articulate proposed programmatic milestones tied to their use of funds. Milestones will be used to negotiate payments and payment schedules with Natcast, if selected. Applicants may include proposed milestones to stand up programs, such as an initial advance payment. Milestones should represent significant operational achievements or deliverables – such as hiring of key personnel, contracting with necessary partners, or payments for completion of training curriculum – and major performance outcomes, such as completion of cohort training, enrollment of participants into jobs, or similar activities in alignment with the proposed scope, as described in their application.

Table of Cost Share and Contributors

Where voluntary, committed cost share is offered, a table with details about all contributing sources of cost share, both cash and in-kind, including the rationale for selection of the contribution and the merits and risks associated with each known and anticipated contribution.

***Leveraged Resources:** Applicants are not required to provide cost sharing or matching funds. Including such funds is not one of the application screening criteria and applications that include any form of cost sharing or match will not receive additional consideration during the review process. Instead, Natcast considers any resources contributed to the project beyond the funds provided by the agency as leveraged resources. Applicants are strongly encouraged to leverage additional funds to support the project but leveraged resources are not required. Leveraged resources can come from a variety of sources, including, but not limited to, employers, industry associations, labor organizations, community-based organizations, education and training providers, philanthropic organizations, and/or state, and local government*

Domestic Production Plan

Per the guidelines in Section 2.6, applicants must explain the extent to which applicants plan to engage in production within the United States of any intellectual property (in the form of tangible assets) developed through this funding opportunity (e.g., the mask sets and test wafers).

The Proposer must explain, at a minimum, whether and to what extent it plans to produce the mask sets and wafers in the United States. For instance, if the Proposer plans to produce both the mask sets and the wafers in the United States, it should specify the particular vendor and the physical location of that vendor, if known. Conversely, if the Proposer intends to produce either the mask sets or the wafers outside the United States, it must provide the same information (i.e., the specific vendor and city in the chosen country) and additionally explain why production in the United States is not feasible, using the factors listed in Section 2.6 Domestic Production.

Research Security Capabilities

All proposers must describe their research security capabilities and be prepared to develop or improve their research security plans if and when selected for award.

(Insert Organization Name) Research Security Capabilities

Does the organization have an existing research security program (y/n)?

If yes, by submitting this proposal, the proposer acknowledges that depending on an assessment by NIST, it may be asked to improve the described program as a condition of award.

If no, by submitting this proposal, the proposer acknowledges that, if preliminarily selected for an award, the proposer has the capacity and intends to develop a robust Research Security Plan prior to receipt of the award demonstrating that Natcast-funded research and associated data products will be protected. The proposer also acknowledges that progress on implementing such a plan within 90 days of award.

Free-form research security overview

- *Names and positions of organization's leadership*
- *Point of contact*

Organizational Policy

Attach the existing research security policy.

Scope of Program

Describe the research security scope.

Research Security Team

If implemented, provide the research security team membership.

- *Name, position, and e-mail contact*
- *Roles and responsibilities of team members*

Technology and intellectual property assessment

If implemented, attach an existing critical asset list that contains a minimum list of technologies and intellectual property that are pertinent to a funding application that are at risk from foreign adversaries.

Foreign Travel

Does the organization monitor foreign travel and, if so, how?

Communication and training

If implemented, describe the current communication and training strategy. Please include type of training provided.

Technology Control Plans

For an organization with existing TCPs, please attach.

Reviews, Risk Determination, and Mitigation

If implemented, identify a research security review methodology and provide a timeline.

Acceptance and implementation

If a research security plan or program is in development and presently incomplete, outline a proposed implementation timeline for the organization.

Resumes or CVs

Submit for all key personnel, limited to two pages each, highlighting experience relevant to the proposed work.

Current and Pending Support Forms

All "covered individuals" must enumerate current and pending support information for all federally funded research projects using NIST's standard form, found at <https://www.nist.gov/system/files/documents/2024/05/02/NIST%20Current%20and%20Pending%20Support%20Form%20-%205.1.24%20FINAL.pdf>. A covered individual is defined as a person who contributes in a substantive, meaningful way to the scientific development or execution of a research and development project proposed. To facilitate the submission of this information, proposers may use alternative formats, provided that they include all the information required in the NIST Current and Pending (Other) Support Common Form linked above.

Letters of Commitment

Each partner organization and/or subgrantee cited by the lead applicant as providing services to support the program model and lead applicant must submit a Letter of Commitment.

Letters of Commitment must address the level of participation, qualifications of the personnel who will be actively involved, and how successful completion of this project would positively impact their profession or community. Letters must be signed by an individual with authority to legally bind the organization to its commitment. Letters of Commitment must also specify any voluntary committed cost-share, including the specific services and/or products to be used in the project...

Letters of Support

Letters of support may be appended to a proposal to express support for the work and provide evidence of users interested in the proposed test vehicles. Each letter must not be longer than 1 page and must be signed with an appropriate organizational letterhead.

8.2 Appendix B: Research Security Plan Questionnaire

The information in this questionnaire is needed only at award negotiation time

8.2.1 (Insert Organization Name) Research Security Plan

Organizational leadership

Identify the organization's leadership.

- *Name of organization*
- *Names and positions of organization's leadership*
- *Point of contact*

Organizational Policy

Attach the existing research security policy or the intent to develop such policy. For an organization needing to create a research security policy, please provide a timeline.

Scope of Program

Provide the research security scope or the intent to develop such scope. For an organization needing to create a research security scope, please provide a timeline.

Research security team

Provide the research security team membership.

- *Name, position, and e-mail contact*
- *Roles and responsibilities of team members*

For an organization needing to create a research security team, please provide a timeline.

Technology and intellectual property assessment

Attach an existing critical asset list that contains a minimum list of technologies and intellectual property that are pertinent to a funding application that are at risk from foreign adversaries.

For an organization needing to create a critical asset list, please provide a timeline.

Communication and training

Describe the current communication and training strategy. Please include type of training provided.

For an organization needing to create a communication and training strategy, please provide proposed communication strategy, a proposed training scope, and a timeline.

Technology Control Plans

For an organization with existing TCPs, please attach.

For an organization without an existing TCP, please identify the intended solution and timeline.

Reviews, Risk Determination, and Mitigation

Identify a research security review methodology and provide a timeline.

Acceptance and Implementation

Outline a proposed research security program implementation timeline for the organization.

8.3 Appendix C: Illustrative Technical Report Template

8.3.1 Outcomes

Major Goals and Objectives:

- *Accomplishments in the current period*
- *Plans for the Next Reporting Period*

8.3.2 Outputs

Publications, Conference Papers, and Presentations

- *List any publications, conference papers, and presentations produced during the reporting period.*

Website(s) or Other Internet Site(s)

- *Provide details of any websites or other internet sites developed as part of the project.*

Technologies or Techniques

- *Describe any new technologies or techniques that were developed.*

Inventions, Patent or Copyright Applications, and/or Licenses

- *List any inventions, patent or copyright applications, and/or licenses that resulted from the project.*

Other Products

- *Detail any other products such as data or databases, physical collections, audio or video products, software, models, educational aids or curricula, instruments or equipment, research material, interventions (e.g., clinical or educational), or new business creation.*

8.3.3 Risks/Problems/Changes

Risks and Risk Mitigation

- *Consider maintaining a running list of significant uncertainties and their perceived impact on the project. Consider a risk matrix covering technical, managerial, and other uncertainties (market, external dependencies) versus impact on the project outcome (low, medium, high) depending on resolution. As progress is made, new risks/uncertainties may appear and others may be settled.*
- *If not already accounted in the project plan, identify any actual or anticipated problems or delays and the actions or plans to resolve them.*

Changes in Approach

Describe any changes in approach to mitigate newly discovered risks or problems, and the reasons for these changes.

Impact on Expenditures and Timeline

Discuss any changes that have a significant impact on the timeline or budget and expenditures and the reason.

8.3.4 Schedule

Capture a high-level schedule that is aligned to the SOW, documenting progress against the baseline plan.

8.3.5 Actuals vs Forecast

Capture spend-to-date against the baseline budget for the cost of work completed. While there is no requirement for an earned value management system, it is expected that the performer maintains some level of internal control over the budgeted work, monitors performance against it, and describes any variances from the plan.

8.4 Appendix D: Illustrative Final Report Template

8.4.1 Introduction

Overview of the project and its objectives

8.4.2 Project Outcomes or Findings

Detailed Description of the project's outcomes or findings Intellectual merit and broader impacts

8.4.3 Publications and Outputs

List of publications, patents, copyrights, presentation, articles, or disclosures of Research Results

8.4.4 Impact Analysis

Comparison of the project's impact to the expected outcomes

8.4.5 Lessons Learned and Recommendations

Insight and recommendation for future NSTC R&D Programs

8.4.5 Transition plans and commercialization

Discuss how to advance the economic goals of the NSTC

8.4.7 Deliverables and Research Byproducts

- *Descriptions, instructions, and artifacts associated with project deliverables and research byproducts, potentially including but not limited to:*
 - *Datasets*
 - *Source code*
 - *Object code*
 - *Curriculum and labs*
 - *Copyrighted materials*

- *Prototypes (mask sets etc.)*

8.4.8 Expected Publication of Results

- *Information on the expected publications of results and other relevant details for NSTC members*

8.4.9 Citations and Links

- *Citations, links to publicly accessible data and other public outputs*