U.S. Department of Transportation

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FY 2018

Small Business Innovation Research (SBIR) Program

Phase I PROGRAM SOLICITATION

NAICS CODE: 541712

Issue Date: January 17, 2018

Closing Date: March 20, 2018, 5:00 PM ET

Small Business Innovation Research (SBIR) Program Office, V-330A
U.S. Department of Transportation (U.S. DOT)
Office of the Assistant Secretary for Research and Technology
John A. Volpe National Transportation Systems Center (Volpe Center)
55 Broadway
Cambridge, MA 02142-1093

QUESTIONS AND IMPORTANT DATES

Administrative and Technical Questions

Before submitting an administrative or technical question, please visit the following web pages:

- The United States Department of Transportation (U.S. DOT) Small Business Innovative Research (SBIR) Program's Frequently Asked Questions (FAQs): http://www.volpe.dot.gov/work-with-us/small-business-innovation-research/frequently-asked-questions. This page provides answers to common administrative questions pertaining to the application process and requirements.

- FY 2018 Administrative and Technical Questions and Answers: http://www.volpe.dot.gov/work-with-us/small-business-innovation-research/-technical-and-administrative-questions. This page provides answers to technical questions regarding specific research topics, along with any administrative questions not listed in the FAQs.

If you have any administrative questions not listed in the FAQs, or any technical questions pertaining to the FY 2018 U.S. DOT SBIR solicitation research topics, please submit such questions via email to the U.S. DOT SBIR Program Office at dotsbir@dot.gov. All questions must be submitted by email.

IMPORTANT DATES:

- **Administrative and technical questions will be accepted through March 1, 2018 at 5:00 PM ET. Questions received after March 1, 2018 may not be answered.**

- **Questions on the Cost Appendix (Appendix C) or how to save it as a PDF will be accepted through March 13, 2018. Please contact the U.S. DOT SBIR Program Office at 617-494-2051 between the hours of 9:00 am and 5:00 pm ET no later than March 13, 2018 for any questions on the Cost Appendix.**

Answers will be posted on the U.S. DOT SBIR Program website continually throughout the solicitation's open period as questions are received and answered. (http://www.volpe.dot.gov/work-with-us/small-business-innovation-research/-technical-and-administrative-questions).

Closing Date

Offers must be received no later than 5:00 P.M. ET on Tuesday, March 20, 2018 through the U.S. DOT automated proposal website at

https://hostedsites.volpe.dot.gov/SBIR/SubmitProposal.aspx. Offers received after that time will be automatically rejected; no exception will be permitted. Please be aware that the submittal process may take several minutes to complete before it is received by the Government due to a multi-step process. Offers will not be considered received by the Government until this multi-step process is complete. Applicants are encouraged to submit their offers as early as possible.

PRE-OFFER WEBINAR

A pre-offer webinar for small business concerns (SBCs) interested in applying to the FY 2018 U.S. DOT SBIR solicitation will be held on **Tuesday, January 23, 2018 at 1:30 PM ET**. SBCs will attend virtually via a webinar conference. All SBCs interested in submitting an offer are urged to attend this webinar, which will provide information on the application process and featured solicitation topics.

Each SBC interested in attending the webinar shall register at: https://volpe-events.webex.com/volpe-events/onstage/g.php?MTID=ec37e61843eafd6a7a64154c686c46d3d

You may register any time prior to noon (12:00 ET) on the day of the conference. Upon receipt of your registration, you will receive information for connecting to the conference.

The webinar recording will be posted to the "Solicitations" section of the U.S. DOT SBIR Program website (https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/solicitations).

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I. PROGRAM DESCRIPTION

A. Introduction

The United States Department of Transportation (U.S. DOT) welcomes small businesses to participate in the U.S. DOT's Small Business Innovation Research (SBIR) program. The purpose of this solicitation is to invite small businesses, with their valuable resources and creative capabilities, to submit innovative research ideas and solutions in response to the topics identified by the U.S. DOT as described in Section VIII. Under the SBIR Program, the U.S. DOT will not accept unsolicited proposals.

The goals and objectives of the SBIR Program are to:

- Stimulate technological innovation;
- Meet Federal research and development needs;
- Foster and encourage participation in innovation and entrepreneurship by socially and economically disadvantaged persons; and
- Increase private sector commercialization of innovations derived from Federal research and development funding.

The SBIR Program encourages small businesses to engage in research or research and development (R/R&D) that has the potential for commercialization and meets Federal R/R&D objectives. The Small Business Innovation Development Act of 1982 (P.L. 97-219 codified at 15 U.S.C. 638) established the SBIR program. In October 1986, through Public Law 99-443, Congress amended the Small Business Act, 15 U.S.C. 638, to extend the SBIR program through September 30, 1993. The Small Business R&D Enhancement Act of 1992 (P.L. 102-564), repealed the SBIR Program under the Small Business Innovation Development Act of 1982 and extended the SBIR Program under the Small Business Act through September 30, 2000. The Small Business Reauthorization Act of 2000 (P.L. 106-554) extended the SBIR Program through September 30, 2008. After a series of continuing resolutions, the SBIR/Small Business Technology Transfer (STTR) Reauthorization Act of 2011 under Public Law 112-81, Section E extended the SBIR Program through September 30, 2017. On December 23, 2016, the President signed into law the National Defense Authorization Act for Fiscal Year 2017. Section 1834 contains the extension of SBIR and STTR programs through September 30, 2022.

The SBIR/STTR Reauthorization Act of 2011 required the U.S. Small Business Administration (SBA) to amend the SBIR Program Policy Directive and related regulations. A summary of the key changes can be viewed on the SBA website: http://www.sba.gov/about-sba-info/174308.

B. Three Phase Program

The U.S. DOT SBIR Program is a three phase process.

THIS SOLICITATION IS FOR PHASE I OFFERS ONLY.

Phase I. Phase I provides support for the conduct of feasibility-related experimental or theoretical research or R/R&D efforts on research topics described herein. The dollar value of the offer may be up to $150,000 unless otherwise noted in Section VIII and is subject to the availability of funding. The period of performance shall be six months. The basis for award is the scientific and technical merit of the offer, its commercial potential, and its relevance to U.S. DOT requirements and current research priorities. The U.S. DOT will award a Firm-Fixed-Price (FFP) contract or bilateral purchase order for Phase I efforts utilizing FAR Part 13 Simplified Acquisition Procedures. A bilateral purchase order is an offer by the Government to buy supplies or services, including research and development, upon specified terms and conditions (in this instance, the contractor's offer), using simplified acquisition procedures. The purchase order is signed by the Contractor and the Government contracting officer.

All U.S. DOT SBIR Phase I awardees are eligible to submit a Phase II proposal for evaluation and possible selection after successful completion of the Phase I effort. Phase I awardees will receive an email from the U.S. DOT SBIR Program Office approximately one month prior to the end of a Phase I contract that provides the timeframe, submittal instructions, evaluation criteria, and location/process for receipt of a Phase II proposal.

Phase II. The objective of Phase II is to continue the R/R&D effort from the completed Phase I. Funding of a Phase II is based on the results of Phase I and the scientific and technical merit and commercial potential of the Phase II proposal. Commercial potential includes the potential to transition the technology to private sector applications, Government applications, or Government contractor applications. Phase II proposals may be funded up to $1,000,000 (except where a lower ceiling is specifically identified) and have a period of performance of up to 24 months. The U.S. DOT typically awards Firm-Fixed-Price (FFP), Level-of-Effort (FFPLOE), or Cost-Plus-Fixed-Fee (CPFF) negotiated contracts for Phase II efforts utilizing FAR Part 15 Contracting by Negotiation procedures. The Government is not obligated to fund any specific Phase II proposal. The U.S. DOT will provide Phase I awardees specific details on the due date, content, and submission requirements for Phase II proposals approximately 30 days prior to the end of Phase I efforts. A summary of Phase II submission requirements can be found on the U.S. DOT's SBIR website at: https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/submit-proposal.

Sequential Phase II awards. The SBIR Program Policy Directive permits agencies to issue one additional, sequential Phase II award to continue the work of an initial Phase II award. These awards are referred to as Phase IIB awards and can be awarded for a period up to 24 months. The funding ceiling typically does not exceed the amount of the previous Phase II award. A small

business may receive no more than two SBIR Phase II awards for the same R&D project, and the awards must be made sequentially. SBIR Awardees must be invited by the U.S. DOT to submit Phase IIB proposals. The U.S. DOT typically awards FFP, FFPLOE or CPFF negotiated contracts for Phase IIB efforts. The same requirements for a Phase II proposal apply here.

Phase III. SBIR Phase III refers to work that derives from, extends, or logically concludes effort(s) performed under a U.S. DOT or another Department's Phase I and/or Phase II funding agreement. Phase III is funded by sources other than the set-aside funds dedicated to the SBIR Program. Phase III work is typically oriented toward commercialization of SBIR research or technology and may be for products, production, services, R/R&D, or a combination. The following activities are types of SBIR Phase III work:

- Commercial application of SBIR-funded R/R&D financed by non-Federal sources of capital.
- SBIR-derived products or services intended for use by the Federal Government, funded by non-SBIR sources of funding.
- Continuation of R/R&D that has been competitively selected using peer review or scientific review criteria, supported by non-SBIR funding.

C. Eligibility

Size Rule. On December 27, 2012, SBA amended its regulations governing size and eligibility requirements for the SBIR and STTR programs. The rule implemented provisions of the National Defense Authorization Act for Fiscal Year 2012 by revising elements of 13 C.F.R. Part 121 that addresses ownership, control, and affiliation for participants in the SBIR program. A summary and explanation of the size rule and changes to program eligibility can be found in the Federal Register, 77 Fed. Reg. 248 (December 27, 2012) pp. 72215-76227 at http://www.sbir.gov/sites/default/files/2012-30809.pdf and SBA's Guide to SBIR/STTR Program Eligibility at http://sbir.gov/sites/default/files/elig_size_compliance_guide.pdf.

The rule includes a provision regarding an agency's option to allow participation by firms that are majority-owned by multiple venture capital operating companies, private equity firms or hedge funds. **The U.S. DOT elects at this time not to use the authority that would allow venture capital operating companies (VCOCs), hedge funds or private equity firms to participate in the SBIR Program.** Offers submitted by these parties will not be considered for award.

- Each SBC submitting an offer must qualify as a SBC at the time of award of Phase I, Phase II and IIB contracts (see Section I. E. for the definition of a SBC). A SBC, together with its affiliates, must not have more than 500 employees. In addition, the following requirements must be met:

- The primary employment of the principal investigator must be with the small business firm at the time of contract award and during the conduct of the proposed research. "Primary employment" means that more than one-half of the principal investigator's time is spent working for the small business. This precludes full-time employment with another organization.
- For Phase I, a minimum of two-thirds of the research or analytical effort, measured in total contract dollars, must be performed by the awardee. For Phase II, a minimum of one-half of the research or analytical effort, measured in total contract dollars, must be performed by the awardee.

Additionally, for Phase I, Phase II and IIB, the R/R&D work must be performed in the United States. "United States" means the 50 states, the Territories and Possessions of the Federal Government, the Commonwealth of Puerto Rico, the Republic of the Marshall Islands, the Federated States of Micronesia, the Republic of Palau, and the District of Columbia.

Performance Benchmark Requirements for Phase I Eligibility

Section 4(a)(3) of the SBIR Policy Directive calls for each Federal agency participating in SBIR to set a Phase II transition rate benchmark in response to Section 5165 of the SBIR/STTR Reauthorization Act of 2011.

Before responding to this solicitation, all applicants should verify their Transition Rate eligibility for Phase I awards on SBA's SBIR website at https://www.sbir.gov/. On June 1st of each year, Phase I applicants that meet the below criteria are eligible to submit an offer for a new Phase I award. General information on the Performance Benchmark requirements is available at https://www.sbir.gov/faqs/performance-benchmarks. The SBIR Performance Benchmark requirements are:

- **Phase I to Phase II Transition Rate**. All small business applicants that have received more than 20 Phase I awards Program-wide (from all Federal Agencies with SBIR programs) are subject to the Phase I to Phase II Transition Rate.

The U.S. DOT's Phase I to Phase II Transition Rate uses a five-year period and counts an applicant's total number of Phase I awards over the last five fiscal years, excluding the most recently completed fiscal year; and the total number of Phase II awards over the last five fiscal years, including the most recently completed year. The U.S. DOT SBIR Phase I to II Transition Benchmark as published in the Federal Register is:

Effective July 25, 2013, for all U.S. DOT SBIR Program Phase I applicants that have received 20 or more Phase I awards over the 5-year period, the ratio of Phase II awards received to Phase I awards received must be at least 0.25.

- Commercialization Rate. The Commercialization Rate is not a requirement for this Solicitation.

D. Contact Information

Contact Information and Instructions

If you have any questions not listed on our website FAQs (https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/frequently-asked-questions), or any administrative or technical questions pertaining to the FY 2018 U.S. DOT SBIR solicitation or research topics, please submit such questions by March 1, 2018 at 5:00 PM ET via email to:

U.S. DOT SBIR Program Office

dotsbir@dot.gov

NOTE: All questions must be submitted via email. Inquiries regarding offer status will not be answered.

For general SBIR Program inquiries not pertaining to this solicitation, please contact:

U.S. DOT's SBIR Hotline

(617) 494 2051

dotsbir@dot.gov

In order to ensure full and open competition and comply with the Procurement Integrity Act, 41 U.S.C. Section 2101-2107 requirements, contact with U.S. DOT relative to this solicitation during the Phase I submittal and evaluation period is restricted to the officials stated in this solicitation. Contact with U.S. DOT officials from any U.S. DOT agency, other than those identified in this solicitation, during the period of this solicitation particularly when the solicitation is open for offers may result in rejection of the offer.

E. Definitions

1. **Funding Agreement**

Any contract, or grant, or cooperative agreement entered into between any Federal Agency and any small business concern for the performance of experimental, developmental, or research work, including products or services, funded in whole or in part by the Federal Government.

2. **Research or Research and Development (R/R&D) Any activity that is:**

- A systematic, intensive study directed toward greater knowledge or understanding of the subject studied;

- A systematic study directed specifically toward applying new knowledge to meet a recognized need; or
- A systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

3. Subcontract

Subcontract means any agreement, other than one involving an employer-employee relationship, entered into by a Federal Government funding agreement awardee calling for supplies or services for the performance of the original funding agreement.

4. SBIR Technical Data

All data generated during the performance of an SBIR award.

5. SBIR Technical Data Rights

The rights an SBIR awardee obtains to data generated during the performance of any SBIR Phase I, Phase II, or Phase III award that an awardee delivers to the Government during or upon completion of a Federally-funded project, and to which the

Government receives a license.

6. Small Business Concern (SBC)

A concern that meets the requirements set forth in 13 CFR § 121.702, which can be found here: http://www.gpo.gov/fdsys/search/pagedetails.action?browsePath=Title+13%2FChapter+I%2FPart+121%2FSubpart+A%2FSubjgrp%2FSection+121.702&granuleId=CFR-2011-title13-vol1-sec121-702&packageId=CFR-2011-title13-vol1.

7. Women-Owned SBC (WOSB)

A WOSB is an SBC that is at least 51% owned by one or more women; or, in the case of any publicly owned business, at least 51% of the stock is owned by women; and women control the management and daily business operations.

8. Veteran-Owned SBC

A Veteran-Owned SBC is one that is at least 51% owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51% of the stock of which is owned by one or more veterans, and the management and daily business operations of which are controlled by one or more veterans.

9. Socially and Economically Disadvantaged SBC (SDB)

See 13 CFR § 124, Subpart B at: https://www.gpo.gov/fdsys/pkg/CFR-2017-title13-vol1/pdf/CFR-2017-title13-vol1-sec124-1.pdf

10. Historically Underutilized Business Zone (HUBZone)

The criteria to be a HUBZone SBC can be found in 13 CFR § 126 at: https://www.gpo.gov/fdsys/pkg/CFR-2017-title13-vol1/pdf/CFR-2017-title13-vol1-sec126-100.pdf

11. Service-Disabled Veteran-Owned SBC

A Service Disabled Veteran-Owned SBC is not less than 51 percent owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and the management and daily business operations are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability the spouse or permanent caregiver of such veteran. Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

12. Economically Disadvantaged Women-Owned Small Business (EDWOSB)

An EDWOSB is at least 51 percent directly and unconditionally owned by, and the management and daily business operations of which are controlled by, one or more women who are citizens of the United States and who are economically disadvantaged in accordance with 13 CFR part 127.

F. Report SBIR Fraud, Waste and Abuse

The Office of Inspector General Hotline (Phone: 800-424-9071, Email: hotline@oig.dot.gov) accepts tips from all sources about potential fraud, waste, abuse and mismanagement in U.S. DOT programs. The reporting individual should indicate that the fraud, waste and/or abuse pertain to an SBIR contract. Additionally, the U.S. DOT SBIR Program website contains information and links to report potential fraud, waste, and abuse: http://www.volpe.dot.gov/work-with-us/small-business-innovation-research/report-fraud-waste-and-abuse.

G. Other Information

Executive Order (EO) 13329, Encouraging Innovation in Manufacturing, February 26, 2004

"Encouraging Innovation in Manufacturing" requires SBIR agencies, to the extent permitted by law and in a manner consistent with the mission of that department or agency, to give high

priority within the SBIR Programs to manufacturing-related R&D. "Manufacturing-related" is defined as "relating to manufacturing processes, equipment and systems; or manufacturing workforce skills and protection."

The U.S. DOT SBIR Program solicits manufacturing-related projects through the call for topics distributed to each of the Department's SBIR participating agencies.

Additionally, the SBA requires each agency with an SBIR program to develop a written policy on the implementation of E.O. 13329 and publish an annual report. The U.S. DOT SBIR Program Office Implementation Plan and Annual Report are posted on the Program website: https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/other-sbir-resources.

Energy Independence and Security Act of 2007, December 19, 2007

The Energy Independence and Security Act of 2007 (P.L. 110-140) amends the Small Business Act (15 U.S.C. Section 636(a)) to instruct the SBA Administrator to ensure that certain Federal Departments and agencies give high priority to small business concerns that participate in or conduct energy efficiency or renewable energy system research and development projects.

The U.S. DOT SBIR Program Office solicits energy efficiency or renewable energy system R/R&D projects through the call for SBIR research topics distributed twice annually to each of the Department's SBIR participating agencies. U.S. DOT SBIR projects that focus on conducting R/R&D in energy efficiency and/or renewable energy are reported annually to SBA.

Federal Leadership on Climate Change and Environmental Sustainability: EO 13693 – Planning for Federal Sustainability in the Next Decade

EO 13693 updated and replaced EO 13514 and requires Federal agencies to give high priority to including sustainability requirements in all federal contracts. DOT strongly encourages all SBIR applicants to include sustainability in their research and development offers. To learn more visit: https://energy.gov/sites/prod/files/2015/09/f26/EO13693.pdf

II. OFFER PREPARATION INSTRUCTIONS AND REQUIREMENTS

A. Overview

This is a solicitation for Phase I R/R&D offers on advanced, innovative concepts from small business concerns (SBCs) having strong capabilities in applied science or engineering. The Phase I R/R&D offers shall demonstrate a sound approach to the investigation of an important transportation related scientific or engineering problem categorized under one of the research topics listed in Section VIII.

An offer may respond to any of the research topics listed in Section VIII herein, but must be limited to one topic. No one offer may be accepted under more than one topic. A small business may, however, submit separate offers on different topics, or different offers on the same topic under this solicitation. Where similar research is discussed under more than one topic, the SBC shall choose that topic which appears to be most relevant to the SBC's technical concept.

The proposed research must have relevance to the improvement of some aspect of the national transportation system or to the enhancement of the ability of an Operating Administration of the U.S. DOT to perform its mission. Offers shall be confined principally to scientific or engineering research, which may be carried out through construction and evaluation. Offers must be for R/R&D, particularly on advanced or innovative concepts.

Each offer shall be self-contained and checked carefully by the Offeror to ensure that all preparation instructions were followed (see Offer Submission Checklist, Appendix D).

All offers must be submitted using the U.S. DOT's SBIR online submittal page: https://hostedsites.volpe.dot.gov/SBIR/SubmitProposal.aspx. An automated notice will be sent via email when the offer is received through the SBIR Program's electronic submission process.

B. Submission Requirements

The following requirements must be met for the offer to be evaluated for award:

1. SBA Company Registry Database – Each SBC applying to the program is required to complete its registration in SBA's Company Registry (http://sbir.gov/registration) prior to submitting its application. Registration requires at least a Data Universal Numbering System (DUNS) identification number or Tax Identification Number (TIN). Completed registrations will receive a unique SBC Control ID and PDF file, which may be submitted as the first page in the Technical Section of the Offer.

2. Offer Layout – Offers must be submitted using the SBIR Program's electronic submission process during open solicitation periods only. Offers must be submitted as three separate files:

   a. **Technical** – The technical section must be submitted in PDF format in accordance with the following requirements:

      i. It shall not exceed 25 pages; the Prior Phase II Awards and SBA Company registry Confirmation do not count towards the 25 pages.
      ii. Font size shall be no smaller than 10 point.
      iii. Offers shall be on standard letter size pages (8.5" by 11").
      iv. All pages shall be numbered consecutively.

   b. **Cost (Appendix C)** – The cost section (Appendix C) may be submitted as an Excel document or PDF and must contain the required supporting information described in the table below. This section does not count towards the 25-page limit for the technical section. There is no limit on the number of pages for Appendix C and its supporting data.

   c. **Appendices A and B** – Appendices A and B must be saved as one single PDF file, which does not count toward the 25-page limit for the technical section.

3. All offers must be submitted using the U.S. DOT's SBIR online submittal page: https://hostedsites.volpe.dot.gov/SBIR/SubmitProposal.aspx. An automated notice will be sent via email when the offer is received through the SBIR Program's electronic submission process. Offers received after the specified due date and time will be automatically rejected; no exception will be permitted. **Please be aware that the submittal process may take several minutes to complete due to a multi-step process. Offers will not be considered received by the Government until this multi-step process is complete. Applicants are encouraged to submit their offers as early as possible.**

Required Sections

Technical (PDF file)

Includes SBA Registry Confirmation, Technical Portion, and Prior Phase II Awards

SBA Company Registry Confirmation	All SBIR applicants are required to be registered in SBA's company registry database. The confirmation from registering in the database should be included as the first page of the PDF document. It does not count towards the 25-page limit. See https://www.sbir.gov/registration to register or print your registration confirmation.
Technical section not to exceed 25 pages	Submitted offers must include the following headings in bold (in cases where a section does not apply, please state "Not Applicable"): 1. **Identification and Significance of the Problem or Opportunity.** State the specific technical problem or innovative research opportunity addressed and its potential benefit to the national transportation system. 2. **Phase I Technical Objectives.** State the specific objectives of the Phase I R/R&D effort; including the technical question(s) the research will try to answer to determine the feasibility of the proposed approach. 3. **Phase I Work Plan.** Describe the Phase I R/R&D plan. The plan shall indicate what will be done, where it will be done, when it will be done, and how the R/R&D will be managed or directed and carried out. Phase I R/R&D shall address the objectives and the question(s) cited above in No. 2. Discuss in detail the methods planned to achieve each objective or task, including the level of effort associated with each task. 4. **Related Research or R&D.** Describe significant R/R&D that is directly related to the offer including any R/R&D conducted by the project manager/principal investigator or by the proposing firm. Describe how related research affects the proposed effort, and any planned coordination with outside sources. The SBC must persuade reviewers of its awareness of recent, key R/R&D conducted by others in the specific topic area. 5. **Key Personnel and Bibliography of Directly Related Work.** Identify key personnel involved in Phase I including related education, experience, and bibliographic information. Where vitae are extensive, summaries that focus on the most relevant

Technical portion not to exceed 25 pages (cont'd)	experience or publications are desired and may be necessary to meet page limitation. 6. **Relationship with Future Research and Development.** State the anticipated results of the proposed approach if the project is successful (Phase I and Phase II). Discuss the significance of the Phase I effort in providing a foundation for a Phase II R/R&D effort. 7. **Facilities.** Provide a detailed description of the availability and location of instrumentation and physical facilities proposed for Phase I. 8. **Subcontractor/Consultants.** Involvement of consultants in the planning and research stages of the project is permitted. Describe any intended involvement in detail. Consultants are permitted to conduct no more than one-third of the work, measured in total contract dollars. 9. **Potential Post Applications.** Briefly describe whether and how the proposed project appears to have (1) potential commercial application; and (2) potential use by the Federal Government. 10. **Similar Offers and/or Awards.** While it is allowed, with notification, to submit identical offers or offers containing a significant amount of essentially equivalent work for consideration under numerous federal program solicitations, **it is unlawful to enter into funding agreements requiring essentially equivalent effort**. If there is any question concerning this, it must be disclosed to the soliciting agency or agencies before award. If an SBC elects to submit similar or identical offers containing equivalent work under other Federal program solicitations, a statement must be included in each offer indicating: • The name and address of the agencies to which offers were submitted or from which awards were received; • Date of offer submission or date of award; • Title, number, and date of SBIR Program solicitations under which offers were submitted or awards received; • The applicable research topics for each SBIR offer submitted or award received; • Titles of research projects; • Name and Title of Principal Investigator or Program Manager for each offer submitted or award received. 11. **Human Factors**, Research that involves human subjects may be subject to additional regulations found in 49 C.F.R. Part 11

Technical portion not to exceed 25 pages (cont'd)	(Part 11) as well as other applicable federal and state laws and regulations. Research will be considered to involve human subjects under Part 11 if the research obtains (1) data through intervention or interaction with an individual(s), and/or (2) identifiable private information. Unless exempt under 49 C.F.R. §11.101(b) or §11.101(i), human subject research must adhere to the regulations of Part 11, which includes review and approval of the research by a federally approved Institutional Review Board (IRB). Due to the short timeframe associated with Phase I of the SBIR process, the DOT does not recommend the submission of Phase I offers that require the use of Human Subjects Testing. For example, the ability to obtain Institutional Review Board (IRB) approval for offers that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time to award. Before the DOT makes any award that involves an IRB or similar approval requirement, the offeror must demonstrate compliance with relevant regulatory approval requirements that pertain to offers involving human protocols. It will not impact the DOT's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. 12. **Sustainable Acquisition Requirement.** SBC's technical section will be used as the Statement of Work (SOW) under any award resulting from this solicitation under SBIR Phase I or II. Consistent with FAR Part 23, each SBC is expected to include and abide by the following in its technical offer: "**Sustainable Acquisition Requirement:** To the maximum extent possible and consistent with the Federal Acquisition Regulations Part 23, the Government requires during the performance of the work under this Statement of Work (SOW) the Contractor to provide or use products that are: energy efficient (ENERGY STAR® or Federal Energy Management Program (FEMA)-designated); water-efficient; biobased; environmentally preferable (e.g., EPEAT-registered, or non-toxic or less toxic alternatives); made with recovered materials; or non-ozone depleting that minimize or eliminate, when feasible, the use, release, or

	emission of high global warming potential hydrofluorocarbons, such as by using reclaimed instead of virgin hydrofluorocarbons. Unless otherwise identified in this SOW, each recovered materials or biobased product provided and delivered must meet, but may exceed, the minimum recovered materials or biobased content of an EPA- or USDA-designated product. The sustainable acquisition requirements specified herein apply only to products that are required to be: (1) delivered to the Government during contract performance; (2) acquired by the contractor for use in performing services (including construction) at a Federally-controlled facility; (3) furnished by the contractor for use by the Government; or (4) specified in the design of a building or work, or incorporated during its construction, renovation, or maintenance. Inclusion of this general requirement does not relieve the SBC from including in its technical section explicit sustainability requirements applicable to the R/R&D being offered (see BioPreferred website at http://www.biopreferred.gov/BioPreferred/)."
Prior SBIR Phase II Awards (does not count toward the 25-page limit for technical)	If the SBC has received more than a total of 15 Phase II awards in the prior five fiscal years, submit the name of the awarding agency, date of award, funding agreement number, dollar amount, topic or subtopic title, follow-on agreement dollar amount, source and date of commitment, and current commercialization status for each Phase II. Provide the name and title of the project manager or principal investigator for each offer submitted or award received.

Cost (Appendix C) (Excel or PDF)

Appendix C is available on our website here in Microsoft Excel 2010 format.	A Firm-Fixed-Price Phase I Contract Pricing section must be submitted in detail using the template provided in Appendix C. Some cost breakdown items of Appendix C **may not apply** to the proposed project. If such is the case, there is no need to provide information for each and every item. When completing your cost offer, please consider the following:

Specific instructions for filling out Appendix C are located here. *See a sample cost submission offer here.*	• It is important to provide enough information to allow the U.S. DOT to understand how the SBC plans to use the requested funds if an award is made. • Phase I contract awards may include profit. Note: Firm-Fixed-Price is the type of contract used for Phase I SBIR awards. • Travel is allowable however unusual for Phase I projects. • A firm must note its TIN and Data Universal Numbering System (DUNS) identification number in Appendix C, in the Cost and Pricing Offer/Proposal Coversheet. The DUNS is assigned by Dun & Bradstreet, Inc. (See III (D) below). If you are not able to receive a DUNS number before the solicitation deadline, please indicate "Pending" in the DUNS field of Appendix C. An Offeror must have a DUNS number before a funding agreement can be awarded. Please fill out the spreadsheets as directed. If an Offeror is submitting supporting information (e.g., price quotes or subcontractor commitments) then save the entire workbook as a PDF. To do this, click on the 'Acrobat' tab in the main ribbon of Excel, then choose "entire Workbook" from the Conversion Range option at the top of window.) If you have any trouble accessing the Appendix C spreadsheet or saving it as a PDF please contact the U.S. DOT SBIR Program Office at 617-494-2051 between the hours of 9:00 am and 5:00 pm ET no later than March 13, 2018. Offers that exceed the Phase I Estimated Award Amount listed in Section VIII will not be considered for award.

Appendices A and B (PDF)

Signature Page (Appendix A) *Page 1 of PDF*	Complete the signature page in Appendix A. All pages shall be numbered consecutively beginning with the signature page.
Project Summary (Appendix B) *Page 2 of PDF*	Complete the Project Summary Sheet in Appendix B as Page 2 of the offer. The Project Summary of successful offers may be published by the U.S. DOT and, therefore, shall not contain classified or proprietary information. The Project Summary must include at a minimum:

	1. A technical abstract with a brief statement of the problem or opportunity, project objectives, and description of the effort. o The technical abstract shall be limited to 200 words in the space provided on the Project Summary sheet. Any words or statements beyond the 200-word limit may not be considered for award purposes. 2. Anticipated results and potential applications of the proposed research

C. Other Information

1. Offers will be available only to the U.S. DOT team of engineers and/or scientists responsible for evaluating the offer, the U.S. DOT SBIR Program Office, and Volpe Center staff pertinent to the SBIR program.

2. **Fraudulent Information**. Submitting plagiarized information and/or false information pertaining to the company, the principal investigator and/or work to be performed may result in:

    a. Cancellation of the topic within a solicitation;
    b. An offer being deemed non-responsive;
    c. A recommendation for Phase I award being rescinded; or
    d. Termination of an award.

3. **Discretionary Technical Assistance**. The SBIR Program Policy Directive permits an agency to provide technical assistance to an SBIR awardee in an amount not more than $5,000 per year. This amount is in addition to the award amount.

    The purpose of the Technical Assistance, as defined by the SBA Policy Directive, is to assist SBIR awardees in: (1) making better technical decisions on SBIR projects; (2) solving technical problems that arise during SBIR projects; (3) minimizing technical risks associated with SBIR projects; and (4) commercializing the SBIR products or processes. **The U.S. DOT SBIR Program will provide assistance to Phase I awardees in the area of commercialization planning and strategy. The program shall be referred to as the DOT SBIR Commercialization Assistance Program (CAP).**

    U.S. DOT SBIR awardees can receive support through the CAP in one of two ways:

        a. The U.S. DOT SBIR Program Office has a Blanket Purchase Agreement with Dawnbreaker Incorporated (2117 Buffalo Road, Rochester, NY) that can provide support to Phase I and Phase II awardees. Once an offer is recommended for award, the prospective awardees will receive notification from the U.S. DOT SBIR Program Office identifying the services available and guidance on how to obtain these services at no cost to the small business.

These services for Phase I include a kick-off meeting with the CAP vendor and an individualized Commercialization Readiness Assessment to support the development of the Phase II proposal's commercialization strategy, OR

b. Awardees can receive Technical Assistance outside of the SBIR Program Office; however, this technical assistance must be focused on commercialization. To do so, Offerors must, through its own efforts, obtain a Contractor to provide such technical assistance. If recommended for award, the awardee must provide at that time an outline of the specific technical assistance services its proposed Contractor will provide in the area of commercialization planning and strategy, and the detailed qualifications and experience of the proposed Contractor in these areas. This Contractor must have a valid registration in the System for Award Management (SAM) database (https://www.sam.gov). If approved by the U.S. DOT SBIR Program Officer and Contracting Officer, the Government will negotiate a purchase order with the proposed Commercialization Assistance Contractor to work with the SBIR awardee on commercialization efforts in an amount not to exceed $5,000.

4. National Institute of Standards and Technology (NIST)/Hollings Manufacturing Extension Partnership (MEP). An SBC may wish to contact its local NIST Hollings MEP for manufacturing and other business-related support services. The MEP works with small and mid-sized companies to help them create and retain jobs, increase profits, and save time and money. The nationwide network provides a variety of services, from business development assistance to innovation strategies to process improvements and the identification of commercialization opportunities. MEP is a nationwide network of locally managed extension centers with over 1,400 technical experts, located in every state. To contact an MEP center, call 1-800-MEP-4-MFG (1-800-637-4634) or visit MEP's website at http://www.nist.gov/mep.

D. System for Award Management (SAM) and Data Universal Numbering System (DUNS) Identification Number

Any business that would like to work with the Federal Government under a Federal Acquisition Regulation (FAR)-based contract is mandated to be registered in SAM before being awarded a contract. Additional information on SAM and the registration process is provided on the SAM website: https:/www.sam.gov. Businesses that already have a DUNS number can register online at https://www.sam.gov by following the prompts. Instructions for obtaining a DUNS number can be found at: http://fedgov.dnb.com/webform/displayHomePage.do.

III. METHOD OF SELECTION AND EVALUATION CRITERIA

A. General

All Phase I offers will be evaluated and judged on a competitive basis. Initially, all offers will be screened to determine responsiveness to the solicitation. Offers that are responsive to the solicitation requirements will be evaluated by topic experts to determine whether the offer has scientific/technical merit and feasibility (reference B.1 below). Offers that are determined to have merit will be further evaluated for items B.2 – B.4 below.

Each offer will be judged on its own merit. A Phase I award will be made to the responsive and responsible SBC(s) whose offer provides the best value to the Government, based on the technical and scientific merit of the offer. **The U.S. DOT is under no obligation to fund any offer or any specific number of offers on a given topic. For any given topic, U.S. DOT may elect to award more or less than the anticipated quantity of awards stated in Section VIII**.

B. Phase I Evaluation Criteria

The objective of Phase I is to determine the scientific and technical merit and feasibility of the proposed effort and the quality of performance of the SBC. Offers will be evaluated utilizing the following factors:

Scientific/Technical Merit and Feasibility*: Offer shall be evaluated on the relevance and innovation of the proposed effort in response to the specific DOT topical interest area and the overall technical feasibility of the proposed technology/capability.

Effectiveness of the Proposed Work Plan: The proposed work plan shall be evaluated for its comprehensiveness, effective use of resources, and schedule to meet stated objectives.

Experience, Qualifications, and Facilities: Qualifications of proposed Principal Investigator(s) (PI) and other staff, including any subcontractors, shall be evaluated for consistency with the research effort. Instrumentation and/or proposed facilities shall be evaluated for adequacy to conduct research as proposed.

Commercial Potential and Feasibility: Offer shall be evaluated for the commercial potential and feasibility of the proposed solution and associated products/services.

* NOTE: Each responsive offer will be evaluated to determine it has Scientific/Technical Merit and Feasibility. Only offers rated acceptable on Scientific/Technical Merit and Feasibility will be evaluated in the other three factors. An offer found to be unacceptable on Scientific/Technical Merit and Feasibility will not be considered for award.

C. Offer Responsiveness Review

Each offer will be examined to determine if it is complete and contains adequate technical data. **An offer that does not meet the requirements of the solicitation as described in Section II.B may be excluded from consideration, and the SBIR Program Office will send the SBC an email notifying the SBC of its offer's ineligibility for consideration.**

D. Selection of Awardees

The U.S. DOT SBIR Program Office will notify each applicant whether it has been selected for an SBIR Phase I award no later than 90 calendar days after the closing date of this solicitation. At this time, the U.S. DOT SBIR Program Office will also post a listing of Phase I offers recommended for award on the U.S. DOT SBIR Program webpage: http://www.volpe.dot.gov/sbir.

E. Time to Award Requirements

The SBIR Program Policy Directive requires all SBIR agencies to make Phase I awards within 180 days after the close of the solicitation. The purpose of this requirement is to reduce the gap in time between offer submission and time of award. The U.S. DOT SBIR Program Office is required to award a Phase I contract in accordance with the timeframes set forth in the National Defense Authorization Act for FY2012 and the SBIR Program Policy Directive.

F. Debriefing Requests

Debriefing requests must be submitted by e-mail to the SBIR Program Contracting Officer: Tammy Taylor, tammy.taylor@dot.gov within 30 days of notification from the Government of rejection or acceptance of offer. Late requests may be considered on an individual basis. All requests must include: the SBC's name, address, research topic number, and the offer identification number assigned and provided through an automated email notification sent to the SBC upon receipt of its offer. The identity of the evaluators will not be disclosed. Debriefings will be provided by the SBIR Program Contracting Officer who will share a written summary of overall comments received from the Government evaluators.

IV. CONSIDERATIONS

A. Awards

The Government anticipates awarding a total of twelve Phase I awards but reserves the right to make fewer, more, or no awards if it is in the best interest of the Government. The actual number of contract awards is subject to the availability of funding and the responses from small business firms to the solicited research topics described in Section VIII.

1. **Dollar Value of Awards**. The SBIR Program Policy Directive sets the maximum thresholds for Phase I and Phase II awards at $150,000 and $1,000,000, respectively. SBA may adjust these amounts every year for inflation and will post the adjusted numbers on the SBIR website at http://www.sbir.gov. Additionally, the SBIR Policy Directive provides that agencies may not exceed these thresholds by more than 50%, unless the agency requests and is granted a waiver from SBA.

    a. **Phase I Awards**. Phase I awards will utilize FAR Part 13 Simplified Acquisition Procedures. Awards will be FFP contracts or bilateral small purchase orders and may be funded up to $150,000. The period of performance for a Phase I effort is 6 months. Funding levels for each topic are determined by the agency sponsoring the research and are provided in Section VIII. Offers that exceed the Phase I Estimated Award Amount listed in Section VIII will not be considered for award.
    b. **Phase II Awards**. Phase II awards will utilize FAR Part 15 Contracting by Negotiation procedures. Phase II awards may be funded up to $1,000,000. Funding estimates are determined by the agency sponsoring the research. The period of performance for a Phase II effort is up to 24 months and is based on both the funding limit and work to be performed. Phase II funding estimates are provided in Section VIII. Phase II awards are likely to be either FFPLOE or CPFF type contracts, however, each Phase II award contract type will be determined individually.
    c. **Sequential Phase II Awards**. The SBIR Program Policy Directive permits agencies to issue one additional, sequential Phase II award to continue the work of an initial Phase II award. These awards will also be issued under FAR Part 15 and are referred to as Phase IIB awards and can be awarded for a period up to 24 months. A small business may receive no more than two SBIR Phase II awards for the same R&D project, and the awards must be made sequentially.

2. **Phase II Contract Type and Accounting System Audits**. The Contracting Officer will consider whether a Firm Fixed Price Level of Effort (FFPLOE), Cost Plus Fixed Fee (CPFF), or other contract type is appropriate for each Phase II award. Phase II awardees MUST have an acceptable accounting system in place to receive a cost type contract.

B. Reports

Under Phase I SBIR efforts, three reports will be required, consisting of two interim narrative reports, and a comprehensive final report. These reports are spaced at two month intervals starting at the end of month two. An acceptable report is one that is comprehensive and describes all efforts and progression made on the R&D from the start of the funding agreement through the report submitted time.

C. Payment Schedule

Payments for Phase I awards will be made in three equal installments upon submission of invoices, in accordance with instructions in the award document, by the SBC in conjunction with or after the submission of acceptable reports as described in above Paragraph B.

Contracts for Phase II, IIB, and/or III contracts will allow for incremental payments to the successful SBC as work progresses dependent on the negotiated contract type and/or payment schedule.

D. Innovations, Inventions, and Patents

1. **Proprietary Information.** Information contained in unsuccessful offers will remain the property of the SBC. The Government may, however, retain copies of all offers. Public release of information in any offer submitted will be subject to existing statutory and regulatory requirements.

   If proprietary information is provided by a SBC in an offer that constitutes a trade secret, proprietary commercial or financial information, confidential personal information or information effecting national security, it will be treated in confidence, to the extent permitted by law, provided such information is clearly marked by the SBC with the terms "confidential proprietary information" and provided the following legend appears on the title page of the offer:

   "For any purpose other than to evaluate the offer, this proprietary information shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed in whole or in part, provided that if a contract is awarded to this offeror as a result of or in connection with the submission of this information, the Government shall have the right to duplicate, use, or disclose the information to the extent provided in the contract. This restriction does not limit the Government's right to use information contained in the document if obtained from another source without restriction. The information subject to this restriction is contained in page(s) [INSERT] of this offer."

   Any other legend may be unacceptable to the Government and may constitute grounds for return of the offer without further consideration and without assuming any liability for

inadvertent disclosure. The Government will limit dissemination of such information to within official channels.

The U.S. DOT prefers that SBC offers avoid the inclusion of proprietary data. If the inclusion of proprietary data is considered essential for meaningful evaluation of an offer, such data should be provided on a separate page with a numbering system to key it to the appropriate place in the offer.

2. **Rights in Data Developed under SBIR Funding Agreements. Rights in technical data,** including software developed under any award resulting from this solicitation, shall remain with the SBC except that the Government shall have the limited right to use such data for Government purposes and shall not release such data outside the Government without permission of the SBC for a period of four years from completion of the project from which the data was generated. However, effective at the conclusion of the four-year period, the Government shall retain a royalty free license for Federal Government use of any technical data delivered under an SBIR contract whether patented or not.

3. **Copyrights**. With prior written permission of the Contracting Officer, the SBC normally may copyright and publish (consistent with appropriate national security considerations, if any) material developed with U.S. DOT support. The U.S. DOT receives a royalty free license for the Federal Government and requires that each publication contain an appropriate acknowledgement and disclaimer statement.

4. **Patents/Invention Reporting**. SBCs normally may retain the principal worldwide patent rights to any invention developed with Government support. The Government receives a royalty free license for Federal Government use, reserves the right to require the patent holder to license others in certain circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 U.S.C. 205, the Government will not make public any information disclosing a Government-supported invention for a two-year period to allow the SBC a reasonable time to pursue a patent.

5. **Invention Reporting Process**. Awardees shall report SBIR inventions to the U.S. DOT through the iEdison Invention Reporting System (http://www.iedison.gov/). Use of the iEdison System satisfies all invention reporting requirements mandated by any award.

E. Cost Sharing

The U.S. DOT permits cost sharing for its Phase II and Phase IIB efforts under the topic areas identified in this solicitation; however, cost sharing is not required nor will it be a factor in evaluation of offers.

F. Profit

A profit is allowed on Firm-Fixed-Price awards to small business concerns under the U.S. DOT SBIR Program.

G. Joint Ventures or Limited Partnerships

Joint ventures and limited partnerships are permitted provided the entity created qualifies as a small business concern in accordance with the Small Business Act, 15 U.S.C. 632, and the definition included in this solicitation.

H. Research and Analytical Work

For Phase I, a minimum of two-thirds of the research and/or analytical effort, measured in total contract dollars, must be performed by the SBC **unless** otherwise approved in writing by the Contracting Officer.

For Phase II and IIB, a minimum of one-half of the research and/or analytical effort, measured in total contract dollars, must be performed by the SBC **unless** otherwise approved in writing by the Contracting Officer.

I. Awardee Commitments

Upon award of a U.S. DOT SBIR funding agreement, the SBC will be required to make certain legal commitments through acceptance of Federal Acquisition Regulation (FAR) and Transportation Acquisition Regulation (TAR) clauses. The FAR and TAR may be found using the following links:

FAR: https://www.acquisition.gov/far/index.html

TAR: http://www.dot.gov/administrations/assistant-secretary-administration/transportation-acquisition-regulation-tar

The Summary Statements that follow are illustrative of the types of clauses to which the SBC would be committed. This list does not represent a complete list of clauses to be included in Phase I awards, and does not provide the specific wording of such clauses. A complete copy of the terms and conditions will be provided upon issuance of the contract for signature prior to award.

J. Summary Statements

1. Standards of Work. Work performed under all SBIR efforts must conform to high professional standards.

2. Inspection. Work performed under all SBIR efforts are subject to Government inspection and evaluation.

3. Default. The Government may terminate the funding agreement if the Contractor fails to adhere to its terms.

4. Termination for Convenience. The Government may terminate the funding agreement if the Government deems termination to be in its best interest. In such case, the Contractor may submit its costs for work performed and for reasonable termination costs.

5. Disputes. Any dispute concerning the funding agreement which cannot be resolved by agreement shall be decided by the Contracting Officer with right of appeal in accordance with the Contracts Disputes Act of 1978, 41 U.S.C. 71.

6. Equal Opportunity. The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

7. Equal Opportunity for Veterans. The Contractor shall not discriminate against any employee or applicant for employment because he or she is a disabled veteran or veteran of the Vietnam era.

8. Equal Opportunity for Workers with Disabilities. The Contractor shall not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.

9. Officials Not to Benefit. No Government official must benefit personally from the SBIR funding agreement.

10. Gratuities. The Government may terminate the funding agreement if any gratuities were offered to any representative of the Government to secure the award.

11. Patent Infringement. The Contractor shall report each notice or claim of patent infringement based on the performance of the funding agreement to the SBIR Program Contracting Officer.

12. Procurement Integrity. Submission of an offer under this solicitation subjects the Offeror to the "Restrictions on Obtaining and Disclosing Certain Information" (41 U.S.C. §§ 2101-2107, commonly known as the Procurement Integrity Act). This statute, as implemented by Federal Acquisition Regulation (FAR, 48 C.F.R.) §3.104, prohibits the following conduct during an agency procurement: prohibits federal employees and certain Government contractors involved in federal procurements from **disclosing** contractor bid or proposal information or source selection information (§2102); prohibits any individual from obtaining contractor bid or proposal information or source selection information prior to award (§2102); requires agency officials to **report employment**

contacts regarding non-Federal employment (§2103); and bans for a definitive period certain personnel from accepting compensation from the vendor and the vendor from compensating such certain personnel during this definitive period (§2104). Violations of the statute may result in criminal and/or civil penalties, and administrative actions (e.g., suspension and debarment, cancellation of the procurement, and/or rescission of the contract).

13. **Section 508 Access Board Standards**. All electronic and information technology deliverables rendered must comply with Section 508 of the Rehabilitation Act and the Access Board Standards available for viewing at http://www.section508.gov. Unless otherwise indicated, an SBIR awardee represents by signature on a funding agreement that all deliverables will comply with the Access Board Standards.

14. **Government Property**. Materials, equipment, special tooling, and special test equipment either furnished by the Government or acquired by the contractor or fabricated by the contractor is subject to Federal Acquisition Regulation clause 52.245-1 Government Property and may also be subject to special clauses specific to certain items of property.

15. **American Made Equipment and Products**. When purchasing equipment or products under a SBIR funding agreement, purchase only American-made items whenever possible.

K. Additional Information

1. This solicitation reflects current planning. Although not expected, there may be inconsistencies between the information contained in the FY 2018 solicitation and the terms and conditions of any resulting SBIR contract. The terms of the contract once executed are controlling.

2. Before award of an SBIR contract, the SBC shall complete an Online Representations and Certifications Application at https://www.sam.gov. The SBC shall be certified in the designated NAICS code (541712) of this solicitation.

3. The Government may request the SBC to submit additional management, personnel, and financial information to assure responsibility of the SBC.

4. The Government is not responsible for any monies expended by the SBC before award of any contract.

5. This solicitation is not an offer by the Government and does not obligate the Government to make any specific number of awards. Also, awards under this program are contingent upon the availability of funds.

6. The U.S. DOT SBIR Program is not a substitute for existing unsolicited offer mechanisms. Unsolicited offers shall not be accepted under the U.S. DOT SBIR Program for either Phase I or Phase II efforts. For information pertaining to submission requirements for unsolicited offers please refer to the U.S. DOT's Guidelines for Unsolicited Proposal Submission: http://www.volpe.dot.gov/work-with-us/guidelines-unsolicited-proposal-submission.

V. SUBMISSION OF OFFERS

A. Closing Date

Complete offers must be received in the Government system no later than 5:00 P.M. ET on March 20, 2018. Offers received after that time will be automatically rejected; no exception will be permitted. Please be aware that the submittal process may take several minutes to complete due to a multi-step process. Offers will not be considered to be received by the Government until this process is complete. Applicants are encouraged to submit their offers as early as possible.

B. Submission Details

Only one offer shall be submitted. No duplicate offers shall be sent by any other means.

1. Offer Layout – Offers must be submitted using the SBIR Program's electronic submission process during open solicitation periods only. Offers must be submitted as three separate files:
   a. **Technical** – The technical section must be submitted in PDF format in accordance with the following requirements:
      i. It shall not exceed 25 pages; the Prior Phase II Awards and SBA Company registry Confirmation **do not count** towards the 25 pages.
      ii. Font size shall be no smaller than 10 point.
      iii. Offers shall be on standard letter size pages (8.5" by 11").
      iv. All pages shall be numbered consecutively.

   b. **Cost (Appendix C)** – The cost section (Appendix C) may be submitted as an Excel document or PDF and must contain the required supporting information described in the table below. This section does not count toward the 25-page limit for the technical section. There is no limit on the number of pages for Appendix C and its supporting data.

   c. **Appendices A and B**–Appendices A and B must be saved as one single PDF file, which does not count toward the 25-page limit for the technical section.

Offer file names shall include the following:

- The first three characters shall be the topic number the offer is associated with (i.e., FH2).
- The remaining characters must include an abbreviation of the company's name and a distinct character to designate each file (e.g. 1, 2, 3).

C. Submission Website

All offers must be submitted using the U.S. DOT's SBIR online submittal page: https://hostedsites.volpe.dot.gov/SBIR/SubmitProposal.aspx . An automated notice will be sent via email when the offer is received through the SBIR Program's electronic submission process. Please be aware that the submittal process may take several minutes to complete due to a multi-step process. Offers will not be considered received by the Government until this multi-step process is complete. Applicants are encouraged to submit offers as early as possible.

VI. SCIENTIFIC AND TECHNICAL INFORMATION SOURCES

The following publications are referenced in the research topics found in Section VIII.

Federal Highway Administration

18-FH1: Machine Vision System to Support V2I Safety Applications

Federal Highway Administration Highway Performance Monitoring System (HPMS). (2015). Retrieved from https://www.fhwa.dot.gov/policyinformation/hpms.cfm

Federal Railroad Administration

18-FR1: Analysis of Acoustic Wheel/Rail Contact Signals

Federal Railroad Administration Office of Safety Analysis. Retrieved from http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Query/AccidentByRegionStateCounty.aspx

18-FR1: Analysis of Acoustic Wheel/Rail Contact Signal

National Highway Traffic Safety Administration. (2016). *Automated vehicles for safety*. Retrieved from https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

Federal Transit Administration

18-FT1: Virtual and Augmented Reality to Aid Transit Use by All Travelers

Forbes. (2015). *NASA will be taking these augmented reality glasses into space.* Retrieved from https://www.forbes.com/sites/aarontilley/2015/03/11/nasa-odg-augmented-reality-in-space/#1b3068c07497

Intelligent Transportation Systems Joint Program Office Accessible Transportation Technologies Research Initiative Archive. Retrieved from https://www.its.dot.gov/research_archives/attri/attri_progress.htm

NASA. (2017). *Augmented reality application for maintenance, inventory, and stowage*. Retrieved from https://www.nasa.gov/mission_pages/station/research/experiments/2350.html

National Highway Traffic Safety Administration

18-NH2: Fatality Analysis Reporting System (FARS) and Other Crash Data Visualization and Analysis Tool

National Highway Traffic Safety Administration. (2016). *USDOT releases fatal traffic crash data* [Press release]. Retrieved from https://www.nhtsa.gov/press-releases/usdot-releases-2016-fatal-traffic-crash-data

National Highway Traffic Safety Administration Fatal Analysis Reporting System (FARS). Retrieved by https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars

Pipeline and Hazardous Materials Safety Administration

18-PH1: Innovative Technologies for Nondestructive Determination of Fracture Toughness for Pipeline Steels in Transportation Infrastructure

Energy API. (2016). *Energy API catalog: Inspection of refinery equipment* [Brochure]. Retrieved from http://www.api.org/~/media/Files/Publications/Catalog/2016_catalog/06%20Refining.pdf?la=en

VII. SUBMISSION FORMS AND CERTIFICATION (Appendices)

A. Offer Signature Page (Appendix A)

1. MS Word version of Appendix A is available on U.S. DOT's SBIR website.

B. Project Summary (Appendix B)

2. MS Word Version of Appendix B is available on U.S. DOT's SBIR website.

C. Contract Pricing Worksheet (Appendix C)

3. MS Excel Version of Appendix C is available on U.S. DOT's SBIR website.

D. Offer Submission Checklist (Appendix D)

(Do not include with offer – for Offeror's use only)

A. OFFER SIGNATURE PAGE (Appendix A)

U.S. DEPARTMENT OF TRANSPORTATION
SMALL BUSINESS INNOVATION RESEARCH PROGRAM
SOLICITATION NO. 6913G618QSBIR1
FY 2018
SIGNATURE PAGE

Offeror Certification
By signing below and submitting this offer in response to Solicitation No. 6913G618QSBIR1, Topic Number _____, I(We) am(are) representing on my own behalf, and on behalf of the SBIR applicant, that the information provided in this certification, the application, and all other information submitted in connection with this application, is true and correct as the date of the submission. I acknowledge that any intentional or negligent misrepresentation of the information contained in this certification may result in criminal, civil or administrative sanctions, including but not limited to: (1) fines, restitution and/or imprisonment under 18 U.S.C. § 1001; (2) treble damages and civil penalties under the False Claims Act (31 U.S.C. § 3729 *et seq.*); (3) double damages and civil penalties under the Program Fraud Civil Remedies Act (31 U.S.C. § 3801 *et seq.*); (4) civil recovery of award funds, (5) suspension and/or debarment from all Federal procurement and non-procurement transactions (FAR Subpart 9.4 or 2 C.F.R. part 180); and (5) other administrative penalties including termination of SBIR awards.

Principal Investigator Name:	Corporate/Business Official Name:
Title:	Title:
Address:	Address:
Telephone Number:	Telephone Number:
Email:	Email:
Signature:	Signature:
Date:	Date:

B. PROJECT SUMMARY (Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION
SMALL BUSINESS INNOVATION RESEARCH PROGRAM
SOLICITATION NO. 6913G618QSBIR1
FY 2018
PROJECT SUMMARY

Project Summary

Abstract (Limited to two hundred words in this space only. The Project Summary of successful offers may be published by the U.S. DOT and, therefore, shall not contain classified or proprietary information.).

Anticipated Results/Potential Commercial Applications of Results.

Keywords

C. CONTRACT PRICING WORKSHEET (Appendix C)

U.S. DEPARTMENT OF TRANSPORTATION
SMALL BUSINESS INNOVATION RESEARCH PROGRAM
SOLICITATION NO. 6913G618QSBIR1
FY 2018
CONTRACT PRICING WORKSHEET

Appendix C, along with instructions for completing it, can be found on our website here in Microsoft Excel 2010 format. Please fill out the spreadsheets as directed in the instructions. You must submit three separate documents: (1) Technical, (2) Cost (Appendix C), and (3) Appendices A and B to **DOT SBIR's automated proposal site** which is located at: https://hostedsites.volpe.dot.gov/SBIR/SubmitProposal.aspx.

Additional information about the cost submission and its requirements can be found on our website FAQ- https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/frequently-asked-questions.

If you have any trouble accessing or have questions about the Appendix C spreadsheets please contact the U.S. DOT SBIR Program Office at 617-494-2051 between the hours of 9:00 am and 5:00 pm ET no later than March 13, 2018.

D. OFFER SUBMISSION CHECKLIST (Appendix D)

U.S. DEPARTMENT OF TRANSPORTATION
SMALL BUSINESS INNOVATION RESEARCH PROGRAM
SOLICITATION NO. 6913G618QSBIR1
FY 2018
OFFER SUBMISSION CHECKLIST

This is a CHECKLIST OF REQUIREMENTS for your offer. Please review the checklist carefully to assure that your offer meets the U.S. DOT SBIR requirements. Failure to meet these requirements may result in your offer being returned without consideration. (See Section III.B. of this Solicitation). **Do not include this checklist with your offer.**

____ 1. The offer reflects the fact that for Phase I a minimum of two-thirds (and for Phase II a minimum of one-half) of the research and/or analytical effort, measured in total contract dollars, will be performed by the proposing firm as required (see Sections V.H.), and that the primary employment of the principal investigator (for both Phase I and Phase II efforts) must be with the small business firm at the time of award and during the conduct of the proposed research as required (see Section I.C).

____ 2. The offer is submitted according to the requirements described in Section III.

____ 3. The offer is limited to only ONE of the research topics in Section VIII.

____ 4. The budget may be up to $150,000 ***unless otherwise indicated in Section VIII of the solicitation*** and duration does not exceed six months.

____ 5. The technical abstract contains no proprietary information, does not exceed 200 words, and is limited to the space provided on the Project Summary sheet (Appendix B).

____ 6. The offer contains no type smaller than ten point font size.

____ 7. All Appendices have been completed.

____ 8. The TECHNICAL SECTION includes all items identified in Section III.B of the Solicitation.

____ 9. The technical section includes the Sustainable Acquisition Requirement provision (Section III.B.)

____ 10. The additional information on prior Phase II awards, if required, in accordance with Section III.B is included.

____ 11. The Contract Pricing Worksheet (Appendix C) has been completed and provides the necessary supporting information.

____ 12. The offer must be submitted online and received by the U.S. DOT automated proposal website by 5:00 pm ET, March 20, 2018. Offers **received via email or any other means will not be accepted. Do not send duplicate offers via email or by any other means.** Instructions for online submission are included on the submission page.

VIII. RESEARCH TOPICS

The FY 2018 Solicitation Phase I research topics for U.S. DOT Operating Administrations are listed on the following pages. These topics indicate the specific areas for which SBIR Phase I offers are to be considered for acceptance by U.S. DOT. The topics are not listed in any order of priority. Each offer submitted must respond to one (and only one) topic and/or focus area as described in this section. An offer may, however, indicate and describe its relevance to other topics. Offerors are encouraged to review Section VI of this solicitation for scientific and technical information sources that maybe referenced in the respective topic descriptions.

U.S. DOT Operating Administration	Topic Number & Title	Estimated Number of Anticipated Awards	Estimated Award Amount Phase I*	Estimated Award Amount Phase II**
Federal Highway Administration (FHWA)	18-FH1 Machine Vision System to Support Vehicle to Infrastructure (V2I) Safety Applications	2	$150,000	$750,000
	18-FH2 Use of High Resolution Imaging Techniques for Condition Assessment and Damage Detection of Bridges	1	$150,000	$700,000
	18-FH3 Integrated Sensor Unit for Signalized Intersections	1	$150,000	$1,000,000
	18-FH4 An Artificial Intelligence (AI) Based System for Advanced Freeway Data Collection and Analysis	2	$150,000	$1,000,000

* Proposals that exceed the Phase I Estimated Award Amount will not be considered for award.
**The Phase II funding level noted above is an estimate only, is subject to the availability of funds and/or the technical requirements to accelerate the development of a commercial product and/or innovation. Any changes to the Phase II estimated funding level listed above will be communicated to the small business after the completion of the Phase I project.

U.S. DOT Operating Administration	Topic Number & Title	Estimated Number of Anticipated Awards	Estimated Award Amount Phase I*	Estimated Award Amount Phase II**
Federal Railroad Administration (FRA)	18-FR1 Analysis of Acoustic Wheel/Rail Contact Signals	3	$150,000	$500,000
	18-FR2 AI Tools for Relating Various Sensor Data to Adverse Vehicle/Track Inspection	3	$150,000	$500,000
	18-FR3 System Design for Remote and/or Autonomous Operation of a Locomotive Hauled Consist	2	$150,000	$300,000
	18-FR4 Drone-Based Track Safety Inspection System	1	$150,000	$300,000
Federal Transit Administration (FTA)	18-FT1 Virtual and Augmented Reality to Aid Transit Use by All Travelers	3	$150,000	$750,000
National Highway Traffic Safety Administration (NHTSA)	18-NH1 Digital Application to Improve Customers Access to NHTSA Safety Information	1	$150,000	$250,000
	18-NH2 Fatality Analysis Reporting System (FARS) and Other Crash Data Visualization and Analysis Tool	1	$150,000	$200,000
Pipeline and Hazardous Materials Safety Administration (PHMSA)	18-PH1 Innovative Technologies for Nondestructive Determination of Fracture Toughness for Pipeline Steels in Transportation Infrastructure	1	$150,000	$1,000,000
	18-PH2 Dual Purpose Internal Integrity Assessment and Cleaning Tool for Hazardous Liquid Pipelines	1	$150,000	$1,000,000

* Proposals that exceed the Phase I Estimated Award Amount will not be considered for award.
**The Phase II funding level noted above is an estimate only, is subject to the availability of funds and/or the technical requirements to accelerate the development of a commercial product and/or innovation. Any changes to the Phase II estimated funding level listed above will be communicated to the small business after the completion of the Phase I project.

Research topics are organized into five sections:

A. Federal Highway Administration (FHWA)
B. Federal Railroad Administration (FRA)
C. Federal Transit Administration (FTA)
D. National Highway Traffic Safety Administration (NHTSA)
E. Pipeline and Hazardous Materials Safety Administration (PHMSA)

A. Federal Highway Administration (FHWA)

18-FH1: Machine Vision System to Support Vehicle to Infrastructure (V2I) Safety Applications

Today, more than half of all fatalities occur on rural roads that experience less than one third of overall vehicle miles travelled (VMT) (FHWA Highway Performance Monitoring System). There is an obvious disparity in the likely adopters of Automated Driving Systems (ADS) and those who are suffering the greatest numbers of fatalities. ADS could have significant implications for the safety of our surface transportation system. They could reduce vehicle crashes, but could also raise valid concerns for other road users, including pedestrians, bicyclists, and other non-automated passenger vehicles.

Connected-automated vehicle technology depends on the availability of Information and Communications Technology (ICT) infrastructure. Yet rural locations that could benefit most from vehicle safety technologies are less likely to have the needed ICT equipment to support connected-automated vehicle deployment. This topic proposes to supplement the widely accepted ICT approach towards connected automation with the development of machine-readable static signage.

This topic requests the development of a proof-of-concept system in which on-board vehicle machine vision, using standard resolution imaging, can identify and interpret specialized markings on roadside signs. The static signs can convey a machine-readable message that directs the vehicle to download, via satellite radio, radio data system (RDS) FM transmission, or other media, high accuracy roadway geometric information (a.k.a. “MAP” messages) about approaching curves or roadway features that may require the vehicle operator (whether human or machine) to act accordingly. This approach could reduce the costs of Roadside Equipment (RSE) that are currently envisioned to convey such MAP messages. The innovation that is targeted is a low-cost solution that would make Vehicle-to-Infrastructure (V2I) and Connected and Automated Vehicle (CAV) technology economically viable for large sections of the country with limited access to ICT or power to sustain RSE operations.

Static signage placed in locations where ICT infrastructure is unavailable could convey critical messages to connected automated vehicles. This topic considers a system in which onboard, standard-resolution cameras can ‘see’ and ‘read’ static signs that convey a message similar to what a MAP message would if it were broadcast from RSE. On-vehicle logic could interpret the signage and execute appropriate functions, either adjusting ADS behavior directly or alerting a human driver.

For instance, a connected automated vehicle out of range from an RSE point could visually interpret a sign that presents information in machine readable form, much like QR codes that we encounter today. The vehicle would interpret that it is an approach to enter a curve with a low

radius and narrow shoulders. The ADS could then execute a function to decelerate the vehicle so that it can enter the curve safely and with minimized risk of roadway departure.

Alternatively, the static signs could convey machine-readable information on temporary work zones, special events, unusual changes to roadway geometry, presence of midblock pedestrians, presence of animal crossings, and numerous other conditions. The static signs could instruct the vehicle to collect terrestrial or satellite radio transmissions about specific locations towards which the vehicle travels.

The system described in this topic would consist of a standard resolution camera, machine vision algorithms that can filter glare and other distortions, on-vehicle logic for interpreting the machine-readable signs, and the machine-readable signs themselves.

Building a protocol for machine readable signs could accelerate the deployment of connected automation throughout the country, while reducing the costs for implementation on the part of the State and local agencies. This approach could encourage more connected automation vehicle deployments that serve rural and underprivileged communities with limited ICT infrastructure. Furthermore, the system described in this topic could have great value internationally, both in nations with vast rural areas and in the developing world. Creating this technology in the United States for exportation around the world would benefit economic growth and competitiveness.

Expected Phase I Outcomes:

As part of Phase I, the small business will develop a system design that is mature enough to create a proof-of-concept demonstration The conceptual demonstration should showcase a rigorous systems engineering management plan that will lead to a functioning prototype in Phase II. The demonstration, for phase I purposes, may rely primarily on commercial off-the-shelf products and existing MAP message formats. Using MAP message formats allows for the signs to replicate what RSE are broadcasting. In other words, this static sign system would operate as a proxy for RSE for limited vehicle-to-infrastructure applications.

As part of the conceptual demonstration, the Government may provide support by coordinating with other federal and academic entities where controlled proof-of-concept testing can be performed. The Government does have established relationships with other federal facilities, such as the Turner Fairbank Highway Research Center, where such testing could take place. The testing results, including understanding the flaws of the design and how to harden the design for prototype-readiness, can be used to inform the Phase II proposal.

Expected Phase II Outcomes:

Phase II outcomes should include the refinement of the system design for functional prototype testing in simulated and real-world environments. The intent is to deliver the system design to a

stage where it can be commercialized and/or licensed by vehicle manufacturers and suppliers for installation. Work may be needed to develop message content standards on the static signs that conform for the widely accepted standards of today.

18-FH2: Use of High Resolution Imaging Techniques for Condition Assessment and Damage Detection of Bridges

Bridge infrastructure is exposed to various external loads such as traffic and earthquakes during its lifetime. Bridge managers usually rely on visual inspection to assess the condition of a bridge. However, the use of instrumentation and sensing systems in conjunction with a structural model can enhance bridge management. The combination of instrumentation and modeling is commonly classified as structural health monitoring (SHM). Monitoring the structural condition and integrity of bridges is essential for both structural safety and maintenance purposes. Existing bridge SHM systems for measuring structural displacement are expensive to install, operate, and maintain, they are not durable, and data acquisition to support their use is expensive.

Recent advances in digital photography and computational capabilities has enabled the use of digital imaging as a non-contact measurement technique that can measure global structural response information (displacement and deflection) with high resolution and sensitivity using multiple digital cameras positioned at proper stand-off distance from the bridge. This non-contact system usually involves the tracking of a reference target on infrastructure over time. It requires a relatively short period of time for setup, and can be easily set up by a crew of two without any special equipment. It can be used without the interruption of traffic, which allows more frequent inspection and fewer congestion impacts. This technology has been demonstrated in laboratory settings and on actual bridges, but these demonstrations have revealed lower accuracy for field tests compared to a controlled laboratory setting. Therefore, additional field validation is required to improve the accuracy of the acquired data.

The global structural response data might be used for the calibration of computer models. However, this type of global measurement cannot localize the damage in the structure, which is a valid concern for other traditional SHM systems. Therefore, the bridge managers would not be able to utilize the data effectively and extract useful information about the health of the infrastructure asset.

The research to be conducted in Phase I should focus on numerical simulation of methodologies that perform high resolution/high sensitivity, non-contact quantitative assessment of global structural health, and development of post-processing algorithm that localizes damage in the bridge structure. In other words, once the global monitoring solution detects areas of concern, it should be able to identify the specific location of damage (material degradation, delamination, crack, corrosion, etc.) and follow up with closer, more detailed inspection of those areas. The designed system will have the potential to be used for load rating, crack detection and monitoring in both steel and concrete bridges.

Phase II research should focus on further development and refinement of the damage localization algorithm. Phase II should result in the development of a working prototype (both software and hardware), based on the simulation results of Phase I, and then validate and demonstrate the

prototype on a scaled model bridge in a laboratory setting and finally on two actual bridges to perform quantitative assessment of structural health in terms of both global and local quantitative measures.

Expected Phase I Outcomes:

The expected Phase I outcome is a numerical design of a non-contact testing system for high resolution/high sensitivity quantitative assessment of structural health in terms of both global and local quantitative measures in a simulated environment. Also, a post-processing algorithm that localizes the damage in the bridge structure should be developed in Phase I. The designed model and the developed algorithm should be able to collect global responses, and assess and localized damage and its criticality in a numerical simulated environment.

Expected Phase II Outcomes:

One expected Phase II outcome is further development and refinement of an algorithm that can localize the damage in the bridge structure. The second outcome of Phase II would be development of a working prototype (both software and hardware) of the system simulated in Phase I. The prototype should be further demonstrated and validated on a scaled model bridge in a laboratory setting and finally on two actual bridges in a manner that demonstrates the non-contact quantitative assessment of structural health in terms of both global and local quantitative measures. The final product should be able to collect proper global responses, and assess and localize damage and its criticality in actual bridges.

18-FH3: Integrated Sensor Unit for Signalized Intersections

With the advent of connected and automated vehicles, it is imperative that our infrastructure adapt to the changing vehicle technology to improve overall transportation system efficiency. Connected and automated vehicles present an opportunity to optimize signal controls in a way that maximizes traffic signal timing efficiency. However, connected and automated vehicles will be introduced into a large fleet of vehicles that are not connected or automated and will, therefore, need to operate for an extended time with vehicles that are not able to communicate with other vehicles and infrastructure. From a traffic control perspective, in order to provide optimal signal control there is need to be able to identify and track all vehicles in the traffic stream, whether non-connected, connected to the infrastructure (via DSRC or cellular), or connected and automated. Capturing trajectory level information of vehicle arrivals in the traffic stream is a critical step in order for the traffic signal control to provide optimum green times in order to maximize traffic signal timing efficiency.

The objective of this project is to develop an integrated unit that is capable of identifying and tracking individual vehicles using multiple vehicle detection inputs including but not limited to: video images, radar based detection, and wireless signal inputs (including DSRC, cellular, Wi-Fi, and Bluetooth signals). The trajectory-level information of vehicles in the traffic stream is critical to realizing the full potential of connected and automated vehicles in an operational environment. The heart of the proposed integrated unit will be a deep learning-based engine that is able to fuse data from multiple detection inputs in order to track individual vehicles. Deep learning is a subset of machine learning in artificial intelligence that is capable of learning unsupervised from data that is unstructured. Use of a Graphical Processing Unit-(GPU) based platform is integral to implementing deep learning algorithms. For example, some companies have successfully created a GPU-based platform based on deep learning techniques that have been successfully implemented for various automated vehicle applications.

The proposed system is a big step forward in detection technology for signalized intersections and has the potential to make U.S. roadways more amenable to the deployment of connected and autonomous vehicles. The proposed system would offer a single solution for tracking vehicle trajectories regardless of the type of vehicles (connected, connected-automated, conventional) encountered in the traffic stream.

Expected Phase I Outcomes:

Phase I will deliver a report that details the proof-of-concept, including the following:

- Concept of Operations of the proposed system
- Systems Requirement
- Systems Design
- Data Management Platform

Expected Phase II Outcomes:

Phase II work will develop a prototype of the integrated sensor described in Phase I. A demonstration of the prototype will take place at Turner Fairbank Highway Research Center or be conducted elsewhere if circumstances so dictate. Phase II work should also include field operational tests of the unit in coordination with a state or local highway agency.

18-FH4: An Artificial Intelligence (AI) Based System for Advanced Freeway Data Collection and Analysis

Freeway monitoring is an important program for traffic operations, safety, and planning. Currently, most of the data collected from field detection stations are not sent to Traffic Management Centers (TMCs) directly in real time, and are not well organized. Existing data analysis processes are not prepared to meet the needs introduced by advanced traffic operations and coming Connected Vehicle (CV) operations. For example, currently there are 2-3 detections on freeways per mile in metropolitan areas which could support incident detection, congestion management, and planning needs. With more and more CVs on the roadway in the near future, there could be hundreds of data sources per mile – just like hundreds of real-time detection stations. No human brains can handle such a large amount of real-time data and make decisions based on such data. However, the data are very valuable if they could be used in decision support. In this case, artificial intelligence (AI) would be a powerful tool to help operators in data analysis and decision-making based on very valuable new data.

In general, the benefits of the proposed system would be of great assistance in TMC operations, which can reduce congestion and highway delay time. Specific major benefits from this project would include the following:

- Improved highway monitoring process, which would greatly help TMCs' real-time operations and leverage existing collection of data in real-time or near-real-time.
- Better value-added data products generated from this system, which would benefit not only operations, such as incident detection and dynamic traffic control, but also planning and data management practices.
- Improved TMC operations through the integration of the proposed system into existing TMC software used for incident management, dynamic traffic management, travel demand prediction and management, and general decision support systems (DSS).

This project will use several modern technologies to handle collection of large amounts of real-time data, generated by CVs, and to improve the data analysis. These include:

- Developing a prototype device and software which can send detection stations' data to a central location, such as a TMC, through internet-based cloud services. The envisioned software will be capable of sorting and storing the data into a database for further analysis. Some TMCs already have their detection station data posted online, and devices are available for achieving this.
- Using AI software, especially the deep learning tool, to develop the following functionality:

- To continuously monitor, in real time, the tiny variation of freeway traffic flow at each detection station, in terms of speed, acceleration rate, and density, etc., which would be good indicators for an incident, or soon-to-be congestion area/bottleneck.
- To conduct machine learning process, especially the training of artificial neural network (ANN), to identify possible traffic flow issues, including incidents and queues (location and length).
- With the historical database and real-time data, the trained ANN described above should be able to predict congestion, bottlenecks, and locations of high risk of incident. This would allow TMCs to deploy available traffic management resources, such as dynamic traffic control, ramp metering, and incident management crew to the areas where the resources are needed most, which helps solving the problems timely and effectively.

The product from this project (for Phase I and Phase II) includes:

1. A functional prototype system which can cover a 30-mile section of freeway for data collection, and data management.
2. An integrated AI software for predicting locations prone to congestion, bottlenecks, and queues (locations and lengths), as well as high incident rate locations (also supporting incident detection task).
3. A demonstration with at least one TMC, and papers published in national journal to introduce the system.

Expected Phase I Outcomes:

The expected Phase I research will result in a proof-of-concept paper that includes:

- A concept of operations (COO)
- System design, and
- A brief description of the needs for future studies, which could be done in Phase II.

At the conclusion of Phase I, a conceptual demonstration will be conducted at the Federal Highway Administration’s Turner-Fairbank Highway Research Center (TFHRC) or elsewhere if circumstances so dictate. The demonstration will be conducted using a database derived through simulation

Expected Phase II Outcomes:

Phase II research will involve working with one or two State DOT TMCs to select study areas. The work involved includes:

- Developing the prototype system, which shall be connected to a TMC database (using cloud or other suitable means), and shall perform the designed functionality.
- Conducting an evaluation on the field performance, following several months of online operations.
- Conducting a workshop to introduce the technology and the product to other traffic agencies (e.g., State DOTs, city or country traffic agencies, etc.), and publishing papers in national journals to introduce the outcome of the project.
- Making a duplication of the product to showcase at TFHRC's Operations Lab or elsewhere if circumstances so dictate, and conducting a training session for TFHRC staff and on-site contractor.
- A final report detailing the technology, including a user manual.

B. Federal Railroad Administration (FRA)

18-FR1: Analysis of Acoustic Wheel/Rail Contact Signals

In 2016, 1149 railroad derailments were reported in the USA. This represented 70% of the total train accidents (1634) reported that year. Equipment defects were responsible for almost 15% of these derailments, while Track defects were responsible for 29% (FRA Office of Safety Analysis). These derailments caused severe financial and environmental burden, in addition to few fatalities and tens of injuries.

The Federal Railroad Administration (FRA) has been conducting comprehensive research effort that addresses the critical behavior of the wheel/rail interface as it controls the safe behavior of the wheel flange on both curved and tangent track. Few research efforts used vibration measurements and analysis, at the wheel/rail interface, to assess the adverse conditions of the wheel and/or track that may affect the train safety and performance.

FRA is soliciting proposals for innovative approaches that can record and analyze the acoustic signal/noise generated at the wheel/rail interface, and relate the recorded signals to adverse conditions that may hinder the equipment safety and performance. Such adverse conditions that may be of interest might include, but would not be limited to, incipient bearing failure, wheel tread corrugation, brake shoe misapplication or wheel rim or plate cracks, and/or any other condition. The envisioned system would provide the following features:

- Detects and records any abnormal acoustic signal/noise generated at the wheel/rail interface, and filter out any acoustic signal not related to the wheel/rail interface.
- Compares the detected acoustic signal to the normal/standard acoustic signal and evaluates the level of divergence.
- Develop its own analytic and diagnostic technique that can accurately correlate the deviated acoustic signal to adverse wheel/rail conditions, and therefore provide a related diagnostic warning.
- The developed system must be able to operate effectively in adverse conditions including noisy environment, heavy snow, and rain.

Expected Phase I Outcomes:

Outcomes expected from the Phase I include a detailed proof-of-concept that demonstrates how the attributes listed above will be addressed in the prototype. The report should include a preliminary cost estimate of the proposed system (with and without installation).

Expected Phase II Outcomes:

Phase II efforts include extensive testing and demonstration of a working prototype installed on a rolling stock (running at 50 mph speed or more) and testing the effectiveness of the system over a period of 2-3 months. This Phase will require solid Railroad collaboration. It should also illustrate the best proper installation on the railroad rolling stock and how the data will be stored and analyzed.

The prototype testing should prove the proposed concept and demonstrate its effectiveness. This could be achieved through a direct collaboration with any railroad or testing at the Transportation Technology Center, Inc. (TTCI). The awardee will be responsible for arranging a subcontract with TTCI. The awardee will have the option to use FRA's equipment for detecting the acoustic signal and testing the prototype (vendor will be responsible for any associated fee).

18-FR2: AI Tools for Relating Various Sensor Data to Adverse Vehicle/Track Interaction

In 2016, 1149 railroad derailments were reported in the USA, 70% of the total train accidents (1634) reported that year. Equipment defects were responsible for almost 15% of these derailments, while track defects were responsible for 29%. These derailments caused severe financial and environmental burden, in addition to several fatalities and tens of injuries.

FRA is conducting a comprehensive research effort that addresses the critical behavior of the vehicle/track interaction and the role it plays to control the safe behavior of the train on both curved and tangent track. Few research efforts use vibration measurements and analysis at the wheel/rail interface to assess adverse conditions of the wheel and/or track that may affect the train safety and performance. Another ongoing solicitation is seeking proposals for innovative approaches that can record and analyze the acoustic signal generated at the wheel/rail interface, and relate the recorded signals to adverse conditions that may hinder equipment safety and performance.

FRA is soliciting proposals for the development of reliable AI tools and methods for relating various sensor data to adverse vehicle/track interaction. Vendors are encouraged to:

- Use FRA-provided sensor data and/or develop and collect new data using their own sensors.
- Emphasize safety and performance of rail equipment.

The envisioned system would provide the following features:

- Analyze any abnormal sensor data recorded at the vehicle/track interaction, and filter out any unrelated signal(s).
- Compare the detected sensor data to the normal/standard data and evaluate the level of divergence.
- Develop its own AI tools and methods for relating various sensor data to adverse vehicle/track interaction, and therefore provide a related diagnostic warning.

Expected Phase I Outcomes:

Outcomes expected from the Phase I include the development of proof-of-concept design for a system or software that would serve as a tool or method for relating various sensor data to adverse vehicle/track interaction. The report should also include preliminary estimates for the cost of the proposed system (with and without installation).

Expected Phase II Outcomes:

Phase II efforts include extensive testing and demonstration of a working prototype installed on a rolling stock (running at 50 mph speed or more) and testing the effectiveness of the system over a period of 2-3 months. This Phase will require solid Railroad collaboration. It should also illustrate the best proper installation on the railroad rolling stock and how the data will be stored and analyzed. The awardee will have the option to use FRA's equipment either for detecting sensor data and/or testing the developed prototype.

18-FR3: System Design for Remote and/or Autonomous Operation of a Locomotive Hauled Consist

USDOT has released “A Vision for Safety 2.0" which provides voluntary guidelines for automated driving systems (ADSs) at levels which include: conditional assistance, high assistance, and fully automated systems. While intended for application to highway vehicles, much of the guidance is appropriate for railroad applications. Under the new guidance, states and companies do not need to wait to test or deploy their ADSs, either. The Department of Transportation is already planning for the next version 3.0 to make sure automated vehicles can be on the nation's roads safely and quickly.

Many elements of the guidance for remote and fully autonomous operations are clearly easier to achieve for railroad vehicles than they are for highway vehicles. FRA seeks to identify the technical, legal and other barriers to the implementation of autonomous and/or remotely piloted rail vehicles and identify potential avenues to address them. This may include designs for “platooned” operations in which a semi-autonomous train is enabled to follow a train operated by a human crew, by a safe distance.

FRA is soliciting proposals for the development of a system to enable both remote and autonomous operation of a train over revenue service track in the United States. Offerors are encouraged develop and submit a proposal that accomplishes all of the following:

- Identifies the technical requirements for a system which would interface with the locomotive controls in the same manner which a locomotive engineer would,
- Identifies the technical requirements for a system which would interface with the locomotive using existing distributed power technology on a locomotive so equipped,
- Identifies the non-technical barriers to the deployment of autonomous and remotely operated locomotive hauled consists in revenue service, and
- Develops a preliminary design for a system to enable both remote and autonomous operation of a locomotive hauled consist in revenue service.

Expected Phase I Outcomes:

Outcomes expected from the Phase I include the development of proof-of-concept design for a system which could be adapted to existing locomotives to enable the remote and/or autonomous operation of a locomotive hauled consist. The report should include preliminary estimates for the cost of the proposed system (with and without installation). The report should also identify non-technical barriers which may impede the deployment of such technology.

Expected Phase II Outcomes:

Phase II efforts include extensive testing and demonstration of a working prototype installed on a locomotive hauled consist in simulated revenue service and testing the effectiveness of the system over a period of 2-3 months. This Phase will require collaboration with railroad owners/operators. It should also illustrate the best proper installation on a locomotive hauled consist. The awardee will need to identify and obtain support from a railroad partner.

18-FR4: Drone-Based Track Safety Inspection System

This topic seeks to adapt and apply commercially available Unmanned Aerial Vehicle (UAV or Drone) technology, cameras, and automated image analysis algorithms to inspect for railroad track structure conditions that may affect the safe operation of trains. The objective is to gather and compare images from periodic drone-based surveys of railroad track to detect and report changes between surveys that may indicate track degradation. Quantitative measurement of detected changes is not required for early stage research, but the system must accurately and precisely geo-locate the data. Many types of changes should be detected, including, but not limited to: Ballast condition, drainage, mud spots, crosstie condition and skew, rail fasteners, rail condition, joints, switches and other special track work, debris fouling track, etc. Changes in the track structure may be artificially created. The goal of the project is to demonstrate the potential for drone-based safety inspection using commercial hardware and image analysis algorithms. The change detection system shall report change with sufficient resolution to allow an experienced railroad inspector to make accurate decisions regarding the need for on-track inspection and/or remedial action.

Expected Phase I Outcomes:

- Integration of drone, image capture, and image analysis technologies.
- Demonstration of prototype Drone-Based Track Safety Inspection System in an actual or simulated rail environment.
- Technical report

Expected Phase II Outcomes:

- Development of a prototype automated track inspection system with expanded change detection capabilities
- Development of graphical user interface (GUI)
- System testing in adverse conditions (i.e., low light conditions, higher altitudes)
- Development of drone path following capabilities

C. Federal Transit Administration (FTA)

18-FT1: Virtual and Augmented Reality to Aid Transit Use by All Travelers

The U.S.DOT's Accessible Transportation Technologies Research Initiative (ATTRI) at the Intelligent Transportation Systems Joint Program Office seeks to remove barriers to transportation by leveraging advanced technology to enable people to travel independently any time, to any place, regardless of their individual abilities. ATTRI supports the development of applications that will result in an efficient and affordable transportation system that allows individuals with disabilities and all travelers to reliably, safely, and independently plan and execute a seamless complete trip, from origin to destination. The accessibility of a complete trip can be defined in terms of an individual's ability to go from origin to destination without gaps in the travel chain, the links of which include trip planning, travel to station, station/stop use, boarding vehicles, using vehicles, leaving vehicles, using the stop or transferring, and travel to destination after leaving the station/stop. If one link is not accessible, then access to subsequent links become broken and the trip cannot be completed.

Through extensive research and outreach, the ATTRI program has identified four key areas for technology development having the potential to address gaps in the mobility of people with hearing, sight, cognitive, and mobility disabilities: smart wayfinding and navigation; pre-trip concierge and virtualization; robotics and automation; and safe intersection crossing. Augmented and virtual reality (AR/VR) applications have shown particularly strong potential to address the wayfinding and pre-trip planning need areas. ATTRI has also found that AR/VR applications may prove especially useful to those with cognitive impairments, for whom the potential to present useful, digestible information as they plan for, and execute a trip is vital. Additionally, virtual reality has the potential to allow users to experiment and become comfortable with all aspects of trip making before they actually start.

Advances in applying AR/VR to public transit have the potential to help public transportation users become familiar with facilities before ever visiting a train station or bus stop, and to provide a rich layer of data to aid their navigation in the community. Such assistance supports an important link in the trip chain to and from the public transportation vehicle.

An application of this can be seen in the work National Aeronautics and Space Administration (NASA) is already doing. NASA has developed augmented reality (AR) applications to aid astronauts in various tasks, including general maintenance activities in space, by sending instructions in the form of visual aids directly to the user through smartglasses (Augmented Reality Application for Maintenance, Inventory, and Stowage). The use of virtual reality (VR) and AR have been developed to advance NASA's future missions in space. The potential impact means that astronauts could one day get access to advanced computing and visualization instructions or communications in near real-time via smartglasses rather than rely on physical or printed manuals, saving time, resources and payload.

For this topic, such tools may have Earth-bound applications as well, significantly reducing barriers to public transportation use for people with disabilities, particularly cognitive and vision impairments. By building familiarity with the transit environment before starting a trip and providing supportive guidance and reassurance underway, these tools create situational awareness and provide context-based information to support independent travel. This application will help make the complete trip possible for getting from point a to point b and would work both in the built and pedestrian environment as it relates to transit and non-transit use cases so travelers can also understand their transportation options. While the primary target group is travelers with disabilities, this application is envisioned to help the older adults and those who are aging as well as the broader community, benefiting all travelers.

Promoting independent travel among those with cognitive disabilities helps transit agencies reduce paratransit costs, which will face upward pressure with an aging population. Additionally, the benefit to the user, and the community of independence and inclusion, are immeasurable.

VR/AR technologies have potential applications beyond in-station navigation as well. Any member of the public might use these tools to navigate anywhere in the built environment and negotiate required tasks and actions, supporting use of the public transportation system broadly by better connecting riders to resources.

Expected Phase I Outcomes:

The Phase I project should result in a proof-of concept report that describes the proposed prototype, how it will enhance independence across the trip chain segments, and how it will support accessibility for persons with all disabilities types and user groups, e.g. cognitive or older adults, as stated in the ATTRI program. The report should also include a preliminary feasibility study that identifies the potential market demand for a VR/AR package to support transit use familiarization and guidance. Specific reference should be made to the extent to which the proposed solution would enhance independence across the trip chain segments, and a detailed overview of potential use cases for the disability community and beyond.

Expected Phase II Outcomes:

Phase II outcomes will include the development of a market-ready prototype for user testing and possible commercialization. The prototype will be developed in an open-source manner, resulting in product that increases the amount of data available to the user.

D. National Highway Traffic Safety Administration

18-NH1: Digital Application to Improve Consumers Access to NHTSA Safety Information

Consumers seeking to purchase a new or used vehicle can benefit from having access to a large amount of information on vehicle safety, cost, history, and more. Information on safety ratings, safety technology by Vehicle Identification Number (VIN), recalls, makes and models (e.g., owner's manuals), and crash and repair histories are either available publicly on the NHTSA website or available on partner and manufacturer websites. Unfortunately, because this information is spread across several domains, it can be difficult for consumers to find and understand the information they need to make their purchasing decisions and remain informed about their vehicle purchase throughout their ownership. NHTSA is seeking research proposals on how to compile and make accessible this information in a web-based and Smartphone application.

The purpose of this research shall be to develop an easy-to-use web and Smartphone application that can operate on the iPhone, Android, and Blackberry platforms. The approach should incorporate and make accessible the necessary vehicle information to inform purchasing decisions, help educate consumers who have questions about their vehicle's crash avoidance and other attributes, or learn about recalls affecting their vehicles. By better understanding their vehicle purchases with the available safety information, consumers can make more informed choices, be alerted to safety recalls, and understand the safety features available.

The application should integrate information from government and non-government sources. Government sources to consider include, but may not be limited to:

- http://www.safercar.gov – 5 Star NCAP Ratings, Recalls by VIN, File a Vehicle Safety Complaint
- https://vpic.nhtsa.dot.gov/ – Product Information Catalog and Vehicle Listing (vPIC)
- https://www.nhtsa.gov/vehicle – Vehicle Comparison Tool

Expected Phase I Outcomes:

The expected Phase I outcome is a detailed proof-of-concept report that describes the viability of one or more tools and/or approaches for the development and demonstration of an application that could work with multiple databases and websites to provide information to consumers. Such an application should be able to provide information on a specific VIN, generic make and model, and other types of queries a consumer might choose. SBIR welcomes creative approaches to addressing the general objective noted in this topic and specific related challenges identified in research or by the applicant.

Expected Phase II Outcomes:

The expected Phase II outcome is a demonstration of a working prototype of one or more approaches that compiles and makes accessible the necessary vehicle information for consumers, as well as technology results and a marketing plan.

18-NH2: Fatality Analysis Reporting System (FARS) and Other Crash Data Visualization and Analysis Tool

Nationwide, motor vehicle traffic fatalities have increased dramatically (5.6% from 2015 to 2016 (NHTSA 2016 Fatal Traffic Data)) in the past two years. Fatality Analysis Reporting System (FARS) is a nationwide census providing NHTSA, Congress, and the American public yearly data regarding fatal injuries suffered in motor vehicle traffic crashes. FARS contains data derived from fatal motor vehicle traffic crashes within the 50 States, the District of Columbia, and Puerto Rico. This dataset and its associated information are publicly available. FARS codifies every fatal crash with more than 100 data elements using information collected by States and reviewed by expert analysts.

The purpose of this topic is to develop FARS data visualization and analysis tools that will leverage the dataset and help State and local governments develop better training, consumer education/communication, targeted enforcement programs, and/or pursuit of innovative countermeasures to help solve traffic safety issues and better address their needs The visualization tool would ideally be scalable and could potentially also visualize property-damage and injury crashes that States face.

NHTSA is seeking proposals on innovative crash visualization tools that can address the needs of State and local governments, are simple and intuitive for users, as well as compatible with the tools they commonly use. Other potential users are insurance companies, universities, research institutes, and the general public.

Expected Phase I Outcomes:

A Phase I outcome would be proof of concept report that documents the potential unique needs and capabilities of local and State stakeholders and outlines a plan for the development and demonstration of an analysis and visualization tool that could be used for crash data at the local and State level, in particular. Such a tool should be scalable and able to provide information that could be used for countermeasure development and deployment.

Expected Phase II Outcomes:

A Phase II outcome should include a prototype demonstration, including feedback from potential users/buyers, and a marketing plan.

E. Pipeline and Hazardous Materials Safety Administration (PHMSA)

18-PH1: Innovative Technologies for Nondestructive Determination of Fracture Toughness for Pipeline Steels in Transportation Infrastructure

The Pipeline and Hazardous Materials Safety Administration (PHMSA) operates in a dynamic and challenging environment where advances in technology, manufacturing, and energy production impact transportation safety. PHMSA's mission is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.

PHMSA's Office of Pipeline Safety regulates products going through the nation's pipeline infrastructure. The U.S. pipeline infrastructure is the oldest and largest in the world, spanning over 2.7 million miles, and is the primary means of transporting natural gas and liquid petroleum products in the U.S. Because of the significant economic importance and safety consequences of energy pipelines, research projects to improve safety and performance are necessary. Engaging stakeholders- including the public, academia, and industry- is imperative to ensuring such research is effective. The Office of Pipeline Safety funds research improving safety, supply reliability, productivity, and security and mitigate environmental impact. The Office of Pipeline Safety is seeking to support these efforts through this topic.

Adequate knowledge of pipeline materials' fracture toughness is imperative for safe operation. However, existing nondestructive test methods cannot obtain accurate fracture toughness data. Accurate fracture toughness data supports the application of flaw assessment procedures per the American Petroleum Institute Recommended Practice 579 (Energy API Catalog) on fitness-for-service, which can increase the service life of a pipeline through enhanced engineering assessment methods. Standard laboratory tests require pipeline material removal, which can be costly and disruptive by taking the pipeline out of service.

Nondestructive testing for material verification continues to be a research area of keen interest, but fracture toughness of pipeline steel obtained by nondestructive testing during inspections remains challenging.

For this SBIR focus topic, PHMSA Office of Pipeline is seeking proposals demonstrating the potential of an innovative and economically viable solution to obtain material fracture toughness data via nondestructive testing. Successful proposals will define the innovative technology to establish the relationship between nondestructive testing results and laboratory fracture toughness testing on the same materials. The proposals will also address how the technology could be implemented during onsite inspections of pipelines.

Expected Phase I Outcomes:

The Phase I proof-of-concept report is expected to describe the feasibility of and methodology to develop an instrument or method for a field deployable testing solution that can obtain material fracture toughness data via nondestructive testing. The report should include a feasibility analysis supported by data on how the solution would be deployed for use as part of nondestructive inspection programs.

Expected Phase II Outcomes:

The Phase II outcomes will result in a prototype and validation that is expected to lead to full scale initial field tests of a commercially-feasible solution in terms of manufacturing and implementation. This should include the completion of a field-deployable prototype that can be used during direct assessment of assets that are in service. Phase II work should also include:

- An experimental verification that the nondestructive test method can reach sufficient accuracy and reliability to improve condition assessment, and
- A demonstration of the technology on various pipeline steels with a range of toughness characteristics.

18-PH2: Dual Purpose Internal Integrity Assessment and Cleaning Tool for Hazardous Liquid Pipelines

PHMSA operates in a dynamic and challenging environment where advances in technology, manufacturing, and energy production impact transportation safety. PHMSA's mission is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.

PHMSA's Office of Pipeline Safety regulates products going through the nation's pipeline infrastructure. The U.S. pipeline infrastructure is the oldest and largest in the world, spanning over 2.7 million miles, and is the primary means of transporting natural gas and liquid petroleum products in the U.S. Because of the significant economic importance and safety consequences of energy pipelines, research projects to improve safety and performance are necessary. Engaging stakeholders- including the public, academia, and industry- is imperative to ensuring such research is effective. The Office of Pipeline Safety funds research improving safety, supply reliability, productivity, and security and mitigate environmental impact. The Office of Pipeline Safety is seeking to support these efforts through this topic.

There is a continuing need to lower the cost of internal pipeline assessment technologies to reduce overall operating costs, improve data collection, and ensure safety of hazardous liquid pipelines. This SBIR focus topic seeks an alternative means of enhanced In-Line Inspection (ILI) data collection while integrating existing operational maintenance procedures of internal cleaning.

ILI tools are increasingly data intensive; they are capable of quickly inspecting and characterizing defects. Operators are forced to use decision modeling tools for time dependent repair determinations. Pipeline operators conduct operational maintenance of cleaning hazardous liquid pipelines to prevent further corrosion, prepare for a range of ILI inspection runs, or improve throughput and reduce operating costs.

The objective of this focus topic is to develop a dual-purpose ILI/Cleaning tool resulting in time-based data capabilities that provide and refine valuable information to operators on time dependent issues collected over cleaning cycles.

The resulting commercial tool should also include software support to enable operators to deploy he technology as needed with minimal post inspection analysis required. The goal is to encourage more repetitive dual purpose ILI/cleaning runs over a wider use while ensuring safety of the hazardous liquid infrastructure.

Phase I activities may include research and development of a laboratory proof-of-concept to sensing technology capable of being integrated into the tool to demonstrate feasibility of selected components within the tools configuration requirements. The solution should not include heavy

magnets, coupling or other complexities that would increase cost. The solution should provide sufficient resolution for all defects that can be detected with current methods, and ideally with a substantially improved reliability, including defect sizing.

Phase II may include a prototype ILI/Cleaning tool that is relatively light weight and limited in axial length to enable easy transport, deployable through existing cleaning pig traps, and retrieval. The ideal tool should have low initial and operating costs to enable frequent deployment and must be able to address a substantial percentage of pipelines that are currently inspected. One goal is the capability to use this ILI tool where cleaning tools are used.

Additionally, the solution should include software support tools so that only minimal post inspection analysis is required. The goal is to encourage more redundant ILI runs and wider use while ensuring safety of the hazardous liquid pipeline infrastructure.

Expected Phase I Outcomes:

The Phase I proof-of-concept report will describe the proposed solution, including details on the intended detection and cleaning capabilities as compared with existing methods. Results of any analysis and/or initial testing should be described in the report.

Expected Phase II Outcomes:

Phase II will include the fabrication and testing of a working prototype, including an ILI pull-test on representative samples with representative defects under representative conditions. The prototype should provide an ease of handling comparable to a cleaning tool, and an ease of data interpretation.

Upon completion of Phase II, an ideal commercial ILI/Cleaning tool may possess some of the following attributes, where possible.

- Safely transportable by two operators, without lifting for small diameter pipelines.
- Greater than 1000 measurements per second on sufficient number of sensors/channels to provide full circumferential coverage.
- Capable of detecting internal material variances with similar resolution as existing ILI tools.
- Incorporation of standard ILI features (odometers, pig trackers, etc.).