



U. S. Department  
of Transportation

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FY 2022

**Small Business Innovation Research (SBIR)  
Program  
PHASE I PROGRAM SOLICITATION**

**NAICS CODE: 541715**

**Issue Date: February 7, 2022**

**Closing Date: March 7, 2022, 3:00 p.m. (ET)**

**Small Business Innovation Research (SBIR) Program, V-331  
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**

## INFORMATION ABOUT IMPORTANT DATES

Date	Description
February 7, 2022	Solicitation Open Date with amended topics (see below)
	Pre-solicitation Questions & Answers (Q&A) available on the U.S. DOT SBIR website (see Section I.D)
February 9, 2022, 5:00 p.m. (ET)	Registration Deadline for Pre-Offer Webinar (see below)
February 10, 2022, 1:00 p.m. (ET)	Pre-Offer Webinar (see below)
March 1, 2022, 5:00 p.m. (ET)	Administrative and Contract Pricing Worksheet (Appendix C) Questions Due (see Section I.D)
March 7, 2022, 3:00 p.m. (ET)	Solicitation Closing Date (See Section V)
On or about May 9-12, 2022	Pitch Day (see Section III.D)

### A. Solicitation Open with No Amendments to Topics

The proposed topic list shared during the pre-solicitation has no additional amendments.

### B. Pre-Offer Webinar

The Pre-Offer Webinar will be held on Thursday, February 10, 2022, at 1:00 p.m. (ET). The Government encourages all small businesses and persons that are interested in or considering submitting an offer to attend the pre-offer webinar. Small businesses may attend this webinar only virtually via a webinar conference. Come learn about the U.S. DOT's SBIR program, this year's topics, and Pitch Day. Administrative questions about the solicitation will be collected during the webinar, but no technical questions regarding the research topics will be accepted.

To register, visit:

[https://usdot.zoomgov.com/webinar/register/WN\\_Y\\_9S9W1ST9WdrSA\\_ha7DKA](https://usdot.zoomgov.com/webinar/register/WN_Y_9S9W1ST9WdrSA_ha7DKA).

**The deadline to register for the webinar is Wednesday, February 9, 2022, at 5:00 p.m. (ET).**

After the webinar, a recording will be posted to the U.S. DOT SBIR Program website (<https://www.volpe.dot.gov/work-with-us/small-business-innovation-research>).

### C. Closing Date

Offers must be received through the U.S. DOT's automated proposal website, no later than **Monday, March 7, 2022, at 3:00 p.m. (ET)**. The U.S. DOT's automated proposal website is located at [https://usg.valideval.com/teams/usdot\\_2022/signup](https://usg.valideval.com/teams/usdot_2022/signup).

## **D. Pitch Day**

The most favorably rated offers for the respective research topics (per Section III.D) will have an opportunity to make a virtual oral presentation to the Government promoting its offer. Pitch Day is scheduled on or around May 9-12, 2022. For more information, see Section III.D.

# CONTENTS

<b>INFORMATION ABOUT IMPORTANT DATES.....</b>	<b>I</b>
A. SOLICITATION OPEN WITH AMENDED TOPICS.....	I
B. PRE-OFFER WEBINAR.....	I
C. CLOSING DATE.....	I
D. PITCH DAY.....	II
<b>I. PROGRAM DESCRIPTION .....</b>	<b>1</b>
A. INTRODUCTION .....	1
B. THREE-PHASE PROGRAM .....	1
C. ELIGIBILITY.....	3
<i>Size Rule</i> .....	3
<i>Performance Benchmark Requirements for Phase I Eligibility</i> .....	3
D. CONTACT INFORMATION .....	5
E. DEFINITIONS .....	6
<i>Funding Agreement</i> .....	6
<i>Research or Research and Development (R/R&amp;D)</i> .....	6
<i>Subcontract</i> .....	6
<i>SBIR Data</i> .....	6
<i>SBIR Data Rights</i> .....	6
<i>Small Business Concern (SBC)</i> .....	7
<i>Veteran-Owned SBC</i> .....	7
<i>Women-Owned SBC (WOSB)</i> .....	7
<i>Socially and Economically Disadvantaged SBC (SDB)</i> .....	7
<i>Historically Underutilized Business Zone (HUBZone)</i> .....	7
F. REPORT SBIR FRAUD, WASTE, AND ABUSE .....	8
G. OTHER INFORMATION .....	8
<i>Executive Order (EO) 13329, Encouraging Innovation in Manufacturing, February 26, 2004</i> .....	8
<i>Energy Independence and Security Act of 2007, December 19, 2007</i> .....	8
<i>Federal Leadership on Climate Change and Environmental Sustainability: EO 13693 – Planning for Federal Sustainability in the Next Decade</i> .....	9
<b>II. OFFER PREPARATION INSTRUCTIONS AND REQUIREMENTS .....</b>	<b>10</b>
A. OVERVIEW.....	10
B. SOLICITATION REQUIREMENTS.....	10
1. <i>SBA Company Registry Confirmation</i> .....	10
2. <i>Submission of Offer</i> .....	11
3. <i>Offer File Names</i> .....	11
4. <i>Offer Submission Deadline</i> .....	12
5. <i>Duplicate Offers</i> .....	12
6. <i>Specific Instructions for the Four Separate Offer Files:</i> .....	12
<i>Technical Section (PDF)</i> .....	12
<i>Appendices A and B (PDF)</i> .....	15
<i>Appendix C: Contract Pricing Worksheet (Excel)</i> .....	15
<i>Contract Pricing Worksheet Supporting Documentation (PDF)</i> .....	16
C. OTHER INFORMATION .....	17
1. <i>Offer Control</i> .....	17
2. <i>Fraudulent Information</i> .....	17
3. <i>Technical and Business Assistance (TABAs)</i> .....	17
4. <i>National Institute of Standards and Technology (NIST)/Hollings Manufacturing Extension</i>	

# U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

<i>Partnership (MEP)</i> .....	18
D. SYSTEM FOR AWARD MANAGEMENT (SAM) AND DATA UNIVERSAL NUMBERING SYSTEM (DUNS) IDENTIFICATION NUMBER	18
<b>III. METHOD OF SELECTION AND EVALUATION CRITERIA .....</b>	<b>19</b>
A. BASIS OF AWARD .....	19
B. PHASE I EVALUATION CRITERIA .....	19
C. OFFER RESPONSIVENESS REVIEW .....	19
D. EVALUATION AND SELECTION OF AWARDEES.....	20
E. TIME TO AWARD REQUIREMENTS.....	20
F. DEBRIEFING REQUESTS .....	21
<b>IV. CONSIDERATIONS.....</b>	<b>22</b>
A. FUNDING AWARDS .....	22
B. REPORTS .....	23
C. PAYMENT SCHEDULE .....	23
D. INNOVATIONS, INVENTIONS, AND PATENTS.....	24
E. COST SHARING.....	25
F. PROFIT.....	25
G. JOINT VENTURES OR LIMITED PARTNERSHIPS .....	25
H. RESEARCH AND ANALYTICAL WORK .....	25
I. AWARDEE COMMITMENTS .....	26
J. SUMMARY STATEMENTS .....	26
K. ADDITIONAL INFORMATION .....	28
<b>V. SUBMISSION OF OFFERS.....</b>	<b>30</b>
<b>VI. SCIENTIFIC AND TECHNICAL INFORMATION SOURCES .....</b>	<b>31</b>
A. FEDERAL HIGHWAY ADMINISTRATION (FHWA) .....	31
<i>22-FH1: Enforcement of Bridge Load Postings Using Nondestructive Evaluation Techniques</i> .....	31
<i>22-FH2: AI Video Analysis of Dilemma Zone Conflicts at Signal-Controlled Intersections</i> .....	31
<i>22-FH3: Concrete Curing Quantification</i> .....	31
B. FEDERAL RAILROAD ADMINISTRATION (FRA).....	31
<i>22-FR1: Traction Motor Seizing Device</i> .....	31
<i>22-FR2: Locomotive-Mounted Track Safety Assurance System (LOSAS)</i> .....	32
C. FEDERAL TRANSIT ADMINISTRATION (FTA) .....	32
<i>22-FT1: Reduction of Transit Bus Collisions with Other Vehicles</i> .....	32
<i>22-FT2: Connecting Individuals in “Food Deserts” to Healthy Foods</i> .....	32
<i>22-FT3: Blockchain-Enabled Transit Incentivization</i> .....	32
<i>22-FT4: Tools and Applications Towards Moving to Zero-Emissions</i> .....	32
D. PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION (PHMSA).....	33
<i>22-PH1: Nondestructive, Streamlined Testing and Monitoring of Metal Cylinders and Tanks to Prevent Packaging Failure</i> .....	33
<i>22-PH2: Autonomous Vehicle Leak Detectors</i> .....	33
<i>22-PH3: Vibration Sensing System to Monitor for Potential Excavation Damage</i> .....	33
<i>22-PH4: Underground Natural Gas Storage (UNGS) Advanced Leak Identification and Well Control Solutions</i> .....	33
<b>VII. SUBMISSION FORMS AND CERTIFICATION (APPENDICES) .....</b>	<b>34</b>
A. OFFER SIGNATURE PAGE (APPENDIX A) .....	35
B. PROJECT SUMMARY (APPENDIX B) .....	36
C. CONTRACT PRICING WORKSHEET (APPENDIX C) .....	37
D. OFFER SUBMISSION CHECKLIST (APPENDIX D).....	38
<b>VIII. RESEARCH TOPICS.....</b>	<b>40</b>

**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

A. FEDERAL HIGHWAY ADMINISTRATION (FHWA) ..... 42  
    22-FH1: *Enforcement of Bridge Load Postings Using Nondestructive Evaluation Techniques* ..... 42  
    22-FH2: *AI Video Analysis of Dilemma Zone Conflicts at Signal-Controlled Intersections*..... 43  
    22-FH3: *Concrete Curing Quantification* ..... 45

B. FEDERAL RAILROAD ADMINISTRATION (FRA) ..... 48  
    22-FR1: *Traction Motor Seizing Device* ..... 48  
    22-FR2: *Locomotive-Mounted Track Safety Assurance System (LOSAS)*..... 49

C. FEDERAL TRANSIT ADMINISTRATION (FTA) ..... 52  
    22-FT1: *Reduction of Transit Bus Collisions with Other Vehicles*..... 52  
    22-FT2: *Connecting Individuals in “Food Deserts” to Healthy Foods*..... 54  
    22-FT3: *Blockchain-Enabled Transit Incentivization* ..... 55  
    22-FT4: *Tools and Applications Towards Moving to Zero-Emissions*..... 57

D. PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION (PHMSA) ..... 59  
    22-PH1: *Nondestructive, Streamlined Testing and Monitoring of Metal Cylinders and Tanks to Prevent Packaging Failure*..... 59  
    22-PH2: *Autonomous Vehicle Leak Detectors* ..... 60  
    22-PH3: *Vibration Sensing System to Monitor for Potential Excavation Damage* ..... 61  
    22-PH4: *Underground Natural Gas Storage (UNGS) Advanced Leak Identification and Well Control Solutions* ..... 62

## 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 does not accept unsolicited proposals.

The goals and objectives of the SBIR Program are to:

- Stimulate technological innovation;
- Meet Federal research or research and development (R/R&D) 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 R/R&D funding.

The SBIR Program encourages small businesses to engage in R/R&D that has the potential for commercialization and meets Federal R/R&D objectives. The Small Business Innovation Development Act of 1982 (Public Law (P.L.) 97-219 codified at 15 U.S.C. 638) established the SBIR Program. More information is available at <https://www.sbir.gov/about/about-sbir>.

### B. Three-Phase Program

The U.S. DOT SBIR Program is a three-phase program.

#### **THIS SOLICITATION IS FOR PHASE I OFFERS ONLY.**

**Phase I.** Phase I is the conduct of feasibility-related experimental or theoretical research or R/R&D efforts on research topics described herein. For the U.S. DOT SBIR Program, Phase I offers can be funded up to \$200,000 unless otherwise noted in Section VIII. The period of performance of the resulting contract 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 intends to award Firm-Fixed-Price (FFP) purchase orders utilizing Federal Acquisition Regulation (FAR) Part 13 Simplified Acquisition Procedures. A 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, this solicitation and the contractor's offer). The U.S. DOT will require written acceptance of the purchase order by the SBC at the time of award via the SBC signing the

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

purchase order, thus creating a binding contract between the SBC and the Government. Award of a bilaterally signed purchase order is subject to the availability of funding.

All U.S. DOT SBIR Phase I awardees who have successfully completed Phase I are eligible to submit a Phase II proposal for evaluation and possible selection for award.

**Phase II.** The objective of Phase II is to continue the R/R&D effort from the completed Phase I. Award of a contract for a Phase II effort is based on the results of Phase I, the scientific and technical merit of the Phase II proposal, and the commercial potential of the proposed Phase II project. Commercial potential includes the capability to transition the technology to private sector applications, Government applications, or Government contractor applications. For the U.S. DOT SBIR Program, contracts for Phase II proposals can be funded up to \$1,500,000 (except where a lower ceiling is specifically identified) and can have a period of performance of up to 24 months from the date of contract award. The Government is not obligated to fund any specific Phase II proposal.

The U.S. DOT typically awards Firm-Fixed-Price (FFP), 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. Approximately 30 days prior to the end of Phase I efforts, the U.S. DOT SBIR Program Office will provide Phase I contract awardees details on the due date, content, submission requirements, and evaluation criteria for Phase II proposals. A summary of Phase II proposal 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>.

A Phase II awardee may receive one additional, sequential Phase II award to continue the work of an initial Phase II award.

**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 Agency'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 thereof. 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 SBIR work, funded by non-SBIR sources of Federal funding including R/R&D.



## C. Eligibility

### Size Rule

Regulations governing size and eligibility requirements for the SBIR program are found at 13 C.F.R. Part 121. See SBA's Guide to SBIR/STTR (Small Business Technology Transfer) Program Eligibility at [http://sbir.gov/sites/default/files/elig\\_size\\_compliance\\_guide.pdf](http://sbir.gov/sites/default/files/elig_size_compliance_guide.pdf) for further details. 13 C.F.R. Part 121.702 includes a provision that allows agency discretion relating to the 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 and Phase II 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 at all times during the conduct of the proposed research. "Primary employment" means that more than one-half of the principal investigator's employment time is spent working for the small business. This typically 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 using simple math, must be performed by the awardee (i.e., 66.7% of total contract cost must be for other than subcontractor/consultant costs).
- For Phase II, a minimum of one-half of the research or analytical effort, measured in total contract dollars on costs incurred for personnel, must be performed by the awardee (i.e., labor and indirect rates minus costs such as material, travel, and subcontractor/consultant).
- For both Phase I and Phase II, 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 requires each Federal agency participating in SBIR to set a Phase II transition rate benchmark per Section 5165 of the SBIR/STTR Reauthorization

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Act of 2011. General information on the Performance Benchmark requirements is available at <https://www.sbir.gov/faqs/performance-benchmarks>.

Before submitting an offer to this solicitation, all potential offerors 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 Phase I to Phase II transition rate identified below 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>.

**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 offeror'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 fiscal year. The U.S. DOT SBIR Phase I to II Transition Benchmark is: at least 0.25.

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

### **Commercialization Benchmark:**

The Commercialization Benchmark requirement applies only to SBIR and STTR Phase I applicants that have received more than 15 (16 or more) Phase II awards over the past 10 fiscal years, excluding the last two years. These companies must have achieved at least the minimum required levels of commercialization activity, resulting from their past Phase II work, in order to be eligible to submit a proposal for a new Phase I (or Direct-to-Phase II) award. The current Commercialization Benchmark requirement, agreed upon and established by all 11 SBIR agencies, was published for public comment in the Federal Register (FR) at 78 FR 48537 in August 2013 with a reopening of the comment period at 78 FR 59410 in September 2013. It requires that the awardee applicant must have received, to date, an average of at least \$100,000.00 of sales and/or investments per Phase II award received, or have received a number of patents resulting from the SBIR work equal to or greater than 15% of the number of Phase II awards received during the period.

As of April 2021, the Small Business Administration is enforcing the Commercialization Benchmark and is compiling a list of companies that will be deemed ineligible to submit a proposal for a new Phase I (or Direct-to-Phase II) award due to failure to meet the Commercialization Benchmark requirement.

SBIR and STTR awardees are required to update and maintain their organization's Company Registry Commercialization Report, accessible when logged in to the Company Registry profile

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

as an authorized user under the “My Dashboard” section. Commercialization information is required upon completion of the last deliverable under the funding agreement. SBIR and STTR awardees are requested to voluntarily update the information in the database annually thereafter for a minimum period of 5 years.

### D. Contact Information

If you have any administrative questions not listed on our Frequently Asked Questions (FAQs) web page (<https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/frequently-asked-questions>), or questions regarding this Solicitation’s Appendix C: Contract Pricing Worksheet, please submit such questions via email to:

U.S. DOT SBIR Program Office  
[dotsbir@dot.gov](mailto:dotsbir@dot.gov)

All administrative and Appendix C questions must be submitted no later than 5:00 p.m. (ET) on Tuesday, March 1, 2022. Questions received after 5:00 p.m. (ET) on March 1, 2022, may not be answered. The Government reserves the right to address a late question, if the Government determines an answer is in the best interests of the Government.

#### PLEASE NOTE:

- Technical questions pertaining to the research topics will not be answered during the solicitation period, as technical questions were only permitted during the pre-solicitation period. To review the technical questions and answers, visit <https://usdot.uservoice.com/forums/938697>.
- 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](mailto:dotsbir@dot.gov)

In order to support full and open competition and comply with the Procurement Integrity Act, 41 U.S.C. Sections 2101-2107 requirements, during the Phase I submittal and evaluation period, offeror or potential offeror contact with U.S. DOT relative to this Solicitation is restricted to the officials identified in this Solicitation. During the open period of this Solicitation (from solicitation issuance until release of award recommendation list), contact with U.S. DOT officials (excluding certain offices and positions such as the DOT Office of the Inspector General (see herein) and the U.S. DOT/Office of the Secretary) from or at any U.S. DOT agency, other than those U.S. DOT officials identified in this Solicitation, may result in rejection of the offer determined related to such unauthorized contact.

## E. Definitions

### Funding Agreement

Any contract, 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.

NOTE: The U.S. DOT does not award grants or cooperative agreements under the SBIR Program.

### Research or Research and Development (R/R&D)

Any activity that is:

- A systematic study directed toward greater knowledge or understanding of the subject studied;
- A systematic study directed specifically toward applying knowledge and innovation to meet a recognized but unmet need; or
- A systematic application of knowledge and innovation 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.

### Subcontract

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

### SBIR Data

All data developed or generated during the performance of an SBIR award, including Technical Data and Computer Software developed or generated in the performance of an SBIR award. The term does not include information incidental to contract administration, such as financial, administrative, cost or pricing or management information.

### SBIR Data Rights

The Government's license rights in properly marked SBIR Data during the SBIR protection period as follows: SBIR Technical Data Rights in SBIR Data that are Technical Data or any other type of Data other than Computer Software and SBIR Computer Software Rights in SBIR Data that is Computer Software. Upon expiration of the protection period for SBIR Data, the Government has a royalty-free license to use, and to authorize others to use on its behalf, these

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Data for Government purposes, and is relieved of all disclosure prohibitions and assumes no liability for unauthorized use of these Data by third parties, except that any such Data that is also protected under a subsequent SBIR award shall remain protected through the protection period of that subsequent award. The Government receives unlimited rights in all Form, Fit, and Function Data, Operations, Maintenance, Installation, or Training Purposes (OMIT) Data, and unmarked SBIR Data.

### **Small Business Concern (SBC)**

A concern that meets the SBIR program eligibility requirements set forth in 13 CFR § 121.702, which can be found here: <https://www.law.cornell.edu/cfr/text/13/121.702>.

### **Veteran-Owned SBC**

A Veteran-owned SBC means an SBC:

1. Not less than 51% of which is 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,
2. The management and daily business operations of which are controlled by one or more veterans.

### **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.

### **Socially and Economically Disadvantaged SBC (SDB)**

For Eligibility, and Certification, Relating to Federal Small Disadvantaged Business Programs, See 13 CFR § 124, Subpart B at <https://www.law.cornell.edu/cfr/text/13/part-124/subpart-B>.

### **Historically Underutilized Business Zone (HUBZone)**

A HUBZone SBC means an SBC, certified by the SBA, that appears on the List of Qualified HUBZone SBCs maintained by the SBA (13 CFR § 126.103 at:

<https://www.law.cornell.edu/cfr/text/13/part-126>)

## **F. Report SBIR Fraud, Waste, and Abuse**

The U.S. DOT Office of Inspector General Hotline (Phone: 800-424-9071, Email: [hotline@oig.dot.gov](mailto:hotline@oig.dot.gov)) accepts tips from all sources about allegations of fraud, waste, abuse, and mismanagement in U.S. DOT programs. If the allegations of fraud, waste, abuse or mismanagement pertain to the SBIR Program, then the reporting individual should indicate that the alleged fraud, waste and/or abuse pertains to an SBIR solicitation or contract. Additionally, the U.S. DOT SBIR Program website contains information and links to report potential fraud, waste, and abuse: <https://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 EO 13329 as well as publish an annual report. More information about the U.S. DOT SBIR Program Office Implementation Plan and Annual Report is posted on the Program website: <https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/frequently-asked-questions>.

### **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 priority to small business concerns that participate in or conduct energy efficiency or renewable energy system research and development projects. 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 superseded EO 13514 and requires Federal agencies to include 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://www.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. An SBC 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 compliance with all preparation instructions (see Appendix D, Offer Submission Checklist).

**All offers must be submitted using U.S. DOT's SBIR online submittal page:**  
[https://usg.valideval.com/teams/usdot\\_2022/signup](https://usg.valideval.com/teams/usdot_2022/signup).

### B. Solicitation Requirements

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

1. **SBA Company Registry Confirmation** – Each SBC applying to the SBIR program is required to complete its registration in SBA's Company Registry (<http://sbir.gov/registration>) prior to submitting its application. At a minimum, registration requires a Data Universal Numbering System (DUNS) identification number or Tax Identification Number (TIN). Completed registrations will receive a unique SBC



## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Control ID and PDF file, which should be submitted as the first page in the Technical Section of the Offer.

2. **Submission of Offer** – Offers must be submitted using the U.S. DOT SBIR Program’s [electronic submission process](#) during open solicitation periods only. Offers must be complete, accurate and submitted as four separate files
  - a. **Technical Section** – The technical section must be submitted in PDF format in accordance with the following requirements:
    - i. The technical section shall not exceed 15 pages. A Table of Contents, the SBA Company Registry Confirmation, and Prior Phase II Awards do not count towards the 15 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 should be numbered consecutively.
  - b. **Appendices A and B** – Appendix A: Signature Page and Appendix B: Project Summary must be submitted as a PDF file, which does not count toward the 15-page limit for the technical section.
  - c. **Appendix C: Contract Pricing Worksheet** – The Contract Pricing Worksheet must be submitted as an Excel file. This section does not count towards the 15-page limit for the technical section. SBCs **must** use the template provided by the U.S. DOT SBIR Program Office in order to be considered responsive.
  - d. **Contract Pricing Worksheet Supporting Documentation** – Supporting documentation for Appendix C: Contract Pricing Worksheet must be submitted as a PDF file, and must include the required supporting information described on page 16 of this Solicitation and in Appendix C. This section does not count towards the 15-page limit for the technical section. There is no limit on the number of pages for the Contract Pricing Worksheet Supporting Documentation.
3. **Offer File Names** – Offer file names for each of the four separate files must include the following:
  - a. The first three characters must be the topic number that the offer is associated with (e.g., FH2).
  - b. 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, and 4).

**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

4. **Offer Submission Deadline** – Offers must be received no later than **3:00 p.m. (ET) on Monday, March 7, 2022**, through U.S. DOT’s automated proposal website at [https://usg.valideval.com/teams/usdot\\_2022/signup](https://usg.valideval.com/teams/usdot_2022/signup). Offers received after that time will be automatically rejected; no exceptions will be permitted. Please be aware that the submittal process requires answering several questions; be sure to allow ample time to complete the multi-step submittal process. Offers shall not be considered received by the Government until this multi-step process is complete. Offerors are encouraged to submit their offers as early as possible.
  
5. **Duplicate Offers** – Only one offer shall be submitted through the U.S. DOT’s automated proposal website. No duplicate offers shall be sent by any other means. 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. An SBC may, however, submit separate offers on different topics, or multiple separate offers on the same topic under this solicitation. **Note: To submit a separate offer in the proposal website, submit the form a second time by adding the new topic number or other distinction at the end of the company name in the Company Name field (e.g., Small Business, Inc. – FH1). This will create a second profile.**
  
6. **Specific Instructions for the Four Separate Offer Files:**

**Technical Section (PDF)**

*Includes SBA Registry Confirmation, Technical Section, and Prior Phase II Awards.*

<p><i>SBA Company Registry Confirmation (does not count toward the 15-page limit)</i></p> <p><i>Page 1 of PDF</i></p>	<p>All SBIR applicants are required to be registered in SBA’s company registry database. The confirmation page from registering in the database should be included as the first page of the Technical Section. It does not count towards the 15-page limit. See <a href="https://www.sbir.gov/registration">https://www.sbir.gov/registration</a> to register or print your registration confirmation.</p>
<p><i>Technical Section (not to exceed 15 pages)</i></p>	<p>Submitted offers are encouraged to have a Table of Contents (which does not count towards the page limit). Offers must include the following headings in bold (in cases where a section does not apply, please state “Not Applicable”):</p> <ol style="list-style-type: none"> <li>1. <b>Identification and Significance of the Problem or Opportunity.</b> State the specific technical problem or innovative research opportunity addressed and its potential benefit to the national transportation system.</li> <li>2. <b>Phase I Technical Objectives.</b> State the specific objectives of the</li> </ol>

U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

	<p>Phase I R/R&amp;D effort; including the technical question(s) the research seeks to answer to determine the feasibility of the proposed approach.</p> <ol style="list-style-type: none"><li>3. <b>Phase I Work Plan.</b> Describe the Phase I R/R&amp;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&amp;D will be managed or directed and carried out. Phase I R/R&amp;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.</li><li>4. <b>Related Research or R&amp;D.</b> Describe significant R/R&amp;D that is directly related to the offer including any R/R&amp;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&amp;D conducted by others in the specific topic area.</li><li>5. <b>Key Personnel and Bibliography of Directly Related Work.</b> 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 experience or publications are desired and may be necessary to meet page limitation.</li><li>6. <b>Relationship with Future Research and Development.</b> 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&amp;D effort.</li><li>7. <b>Facilities.</b> Provide a detailed description of the availability and location of instrumentation and physical facilities proposed for Phase I.</li><li>8. <b>Subcontractors/Consultants.</b> Involvement of consultants in the planning and research stages of the project is permitted. Describe any intended consultant involvement in detail. For Phase I, a maximum of one-third of the research or analytical effort, measured in total contract dollars using simple math, may be performed by subcontractors/consultants.</li><li>9. <b>Potential Post Applications.</b> Briefly describe whether and how the proposed project appears to have (1) potential commercial application; and (2) potential use by the Federal Government.</li><li>10. <b>Similar Offers and/or Awards.</b> While it is allowed, with</li></ol>
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**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

	<p>notification, to submit identical offers or offers containing a significant amount of essentially equivalent work for consideration under numerous federal program solicitations, <b>it is unlawful to enter into funding agreements requiring essentially equivalent effort.</b> 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:</p> <ul style="list-style-type: none"> <li>• The name and address of the agencies to which offers were submitted or from which awards were received;</li> <li>• Date of offer submission or date of award;</li> <li>• Title, number, and date of SBIR Program solicitations under which offers were submitted or awards received;</li> <li>• The applicable research topics for each SBIR offer submitted or award received;</li> <li>• Titles of research projects;</li> <li>• Name and Title of Principal Investigator or Program Manager for each offer submitted or award received.</li> </ul> <p><b>11. Human Factors.</b> Research that involves human subjects may be subject to additional regulations found in 49 C.F.R. Part 11 (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 more information, visit the FAQ at <a href="https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/frequently-asked-questions">https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/frequently-asked-questions</a>.</p>
<p><i>Prior SBIR Phase II Awards (does not count toward the 15-page limit)</i></p>	<p>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</p>

**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

	title of the project manager or principal investigator for each offer submitted or award received.
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**Appendices A and B (PDF)**

<i>Signature Page (<a href="#">Appendix A</a> – page 1 of PDF)</i>	Complete the signature page in Appendix A. The “topic title” block is to list the topic name as shown in this solicitation. The “offer title” block should be the name given to the offeror’s proposed solution and should differ from the topic title block. Sign and date in blocks where indicated; the date used should be the date the offer is submitted to the Government.
<i>Project Summary (<a href="#">Appendix B</a> - page 2 of PDF)</i>	<p>Complete the Project Summary Sheet in Appendix B. The Project Summary of successful offers may be published by U.S. DOT and, therefore, must not contain classified or proprietary information.</p> <p>The Project Summary must include at a minimum:</p> <ol style="list-style-type: none"> <li>1. A technical abstract with a brief statement of the problem or opportunity, project objectives, and description of the effort.             <ol style="list-style-type: none"> <li>a. The technical abstract shall be prepared in accordance with the instructions on the Appendix B Project Summary sheet, e.g., word limit using space on form, no proprietary/classified information.</li> </ol> </li> <li>2. Anticipated results and potential applications of the proposed research.</li> </ol>

**Appendix C: Contract Pricing Worksheet (Excel)**

<i>The required <a href="#">Appendix C</a> template is available on our website in Microsoft Excel 2016 format.</i>	<p>A Phase I Contract Pricing Worksheet must be submitted using the template provided. SBCs must use the template provided by DOT. 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:</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Phase I contract awards may include profit. Note: FFP purchase orders are the type used for Phase I SBIR awards.</li> </ul>
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**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

	<ul style="list-style-type: none"> <li>• Travel is allowable, however, unusual, for Phase I projects.</li> <li>• The SBC must note its TIN and DUNS identification number in Appendix C, in the Contract Pricing Worksheet Coversheet. The DUNS number is assigned by Dun &amp; 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.</li> <li>• If you have any trouble accessing the Appendix C spreadsheet, please contact the U.S. DOT SBIR Program Office via email at <a href="mailto:dotsbir@dot.gov">dotsbir@dot.gov</a> no later than March 1, 2022.</li> <li>• Offers that exceed the Phase I Estimated Award Amount listed in Section VIII will not be considered for award.</li> </ul>
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**Contract Pricing Worksheet Supporting Documentation (PDF)**

<p><i>See the first two tabs of <a href="#">Appendix C</a> for instructions and further examples of supporting documentation.</i></p>	<p>Supporting documentation for the costs and pricing proposed in Appendix C must be submitted as a separate file in PDF format. Supporting documentation must be provided for <b>all</b> costs proposed (e.g., materials quotes, subcontractor proposals, indirect rate calculations, etc.).</p>
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**7. Specific Instructions for Pitch Deck:**

**PITCH DECK (FOR INVITED OFFERORS ONLY)**

**Not part of the initial offer submission.**

<p><i>Pitch Deck (not to exceed 15 slides)</i></p>	<p>Upon invitation only and separate from the initial submission, offerors invited to Pitch Day must submit a pitch deck in MS PowerPoint or PDF via email to the SBIR Program Office (<a href="mailto:dotsbir@dot.gov">dotsbir@dot.gov</a>) no later than 3 business days prior to the event. There is no set format for the slide content.</p> <p>Pitch deck slides are not to be submitted with the initial offer and will not be considered.</p>
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## C. Other Information

1. **Offer Control.** Offers will be available only to Government employees in the U.S. DOT team of engineers and/or scientists responsible for evaluating the offer, the U.S. DOT SBIR Program Office, and/or Volpe Center staff pertinent to the SBIR program. The Government reserves the right to have different evaluators participate in Pitch Day.
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. An offer being deemed non-responsive;
  - b. A recommendation for Phase I award being rescinded;
  - c. Termination of an award; or
  - d. Possible referral to the Suspension and Debarment authority for review and action.
3. **Technical and Business Assistance (TABA).** The SBIR Program Policy Directive permits an agency to provide technical and business assistance to an SBIR awardee. For the U.S. DOT, this amount shall be up to and not exceed \$6,500 for Phase I awards. This amount is in addition to the award amount for Phase I awards.

The purpose of TABA, 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.

A U.S. DOT SBIR awardee can receive support through TABA in one of two ways:

- a. The U.S. DOT SBIR Program Office has a Blanket Purchase Agreement (BPA) with Foresight Science & Technology Incorporated (34 Hayden Rowe St., Hopkinton, MA) that can provide support to Phase I and Phase II awardees. Once an offer is recommended for award, the prospective awardee 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 TABA vendor and an individualized Commercialization Readiness Assessment report to support the development of the Phase II proposal's commercialization strategy,

**OR**

- b. Awardees can receive assistance in an amount not to exceed \$6,500 not using the BPA of the SBIR Program Office. To do so, an awardee must, through its own efforts, obtain a vendor to provide TABA services.

If recommended for award, the awardee must provide at that time of award recommendation an outline of the specific services its proposed vendor will provide and the detailed qualifications and experience of the proposed vendor, as well as pricing information. This information should not be included in the initial offer, the pitch deck (if selected for pitch day), or the Appendix C contract pricing worksheet.

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 seeks to work with the Federal Government under a FAR-based contract is mandated to register in SAM before being awarded a contract. It is recommended that such business register in SAM before submitting an offer as some items in SAM are due at the time of or before offer submission. Additional information on SAM and the registration process is provided on the SAM website at: <https://sam.gov/content/home>. Businesses that already have a DUNS number can register on the SAM website 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. Basis of Award

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. All non-responsive offers will be rejected by the Government and will not be further evaluated.

Each offer will be judged on its own merit. A Phase I contract 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, the U.S. DOT reserves the right to award more or less than the anticipated quantity of awards stated in Section VIII, and to make no awards under a given topic.**

#### B. Phase I Evaluation Criteria

Offerors will be evaluated based on the criteria outlined below. Selections will be based on best value to the Government considering the following criteria, which are listed in descending order of importance. Details of what are considered within each criteria are included below.

<b>Technical Merit &amp; Feasibility</b>	Demonstration of understanding of the problem and solution alignment with the topic description; innovative approach; scientific feasibility
<b>Experience, Qualifications, and Facilities</b>	Description of technical personnel; equipment and facilities; and partnerships/subcontracts (when applicable)
<b>Effectiveness of Proposed Work Plan</b>	Clarity of technical plan and timeline
<b>Commercial Potential</b>	Market understanding and awareness of regulatory, compliance, or legal issues
<b>Offer Quality</b>	Quality of narrative and supporting evidence

#### 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 further consideration.**

## D. Evaluation and Selection of Awardees

Responsive offers will be evaluated in a two-step process in order to reduce the time from submission to selection and award.

1. Each responsive offer will be evaluated against the evaluation criteria described in Section III.B. After evaluations are complete, the most favorably rated offers within each topic will be invited by the Government to move on to the next evaluation step, Pitch Day, and have an opportunity to be considered for award. At the time the Government identifies the offerors that will participate in Pitch Day, all offerors will be notified of their evaluation status. Offerors invited to Pitch Day will receive instructions on how to prepare a short (15-slide maximum) Pitch Deck to present at the event.
2. The most favorably rated offers from step 1 will be invited to attend a virtual Pitch Day event on or around May 9, 2022. At Pitch Day, offerors will have no more than 15 minutes (timed) to present their Pitch Decks to the team of Government evaluators and respond to Government Q&A on the presented pitch.

It is recommended that no more than three individuals attend Pitch Day, and no more than five shall be permitted. Further logistical information will be made available closer to the event.

Pitches will be evaluated against the evaluation criteria described in Section III.B independently of the initial offer. Once Pitch Day evaluations are complete, all Pitch Day offerors will be notified of the offers that the Government is recommending for award. At this time, the U.S. DOT SBIR Program Office will also post a listing of all 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 U.S. DOT SBIR Program Office intends to make recommendations for SBIR Phase I awards no later than 90 days after the closing date of this solicitation. If circumstances are such that notification to each applicant cannot be met within 90 days after the solicitation closing date, the U.S. DOT SBIR Program shall notify each applicant as soon as practicable.

## F. Debriefing Requests

Each offeror will have an opportunity to access a written debriefing regarding the evaluation of its offer. Debriefings will be available electronically via the offer submission website.

Debriefing information will consist of a summary of ratings across all evaluation criteria and may include comments received by the Government evaluators. The identity of the evaluators will not be disclosed. Debriefings will be available as follows:

Offerors who do not advance on to Pitch Day may access its written debriefing within ten (10) calendar days from the notification from the Government. If there is no response from the SBC within these ten (10) calendar days, the debriefing shall close without further notice. Offerors who do advance on to Pitch Day may access feedback regarding their offer within ten (10) calendar days from the notification from the Government, and will also receive information regarding Pitch Day.

Within ten (10) calendar days after Pitch Day, offerors who have participated in Pitch Day may access their debriefings. Offerors will have ten (10) calendar days to access the debriefing. If there is no response from the SBC within these ten (10) calendar days, the debriefing shall close without further notice.

## IV. CONSIDERATIONS

### A. Funding Awards

The Government anticipates awarding a total of thirteen Phase I awards among all the topics identified in this solicitation, 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 U.S. DOT SBIR Program has set the maximum thresholds for Phase I and Phase II awards at \$200,000 and \$1,500,000, respectively.
  - a. **Phase I Awards.** Phase I is the conduct of feasibility-related experimental or theoretical research or R/R&D efforts on research topics described herein. For the U.S. DOT SBIR Program, Phase I offers can be funded up to \$200,000 unless otherwise noted in Section VIII. The period of performance of the resulting contract 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 intends to award Firm-Fixed-Price (FFP) purchase orders utilizing Federal Acquisition Regulation (FAR) Part 13 Simplified Acquisition Procedures. A 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, this solicitation and the contractor's offer). The U.S. DOT will require written acceptance of the purchase order by the SBC at the time of award via the SBC signing the purchase order thus creating a binding contract between the SBC and the Government. Award of a bilaterally signed purchase order is subject to the availability of funding.

All U.S. DOT SBIR Phase I awardees who have successfully completed Phase I are eligible to submit a Phase II proposal for evaluation and possible selection for award.

- b. **Phase II Awards.** The objective of Phase II is to continue the R/R&D effort from the completed Phase I. Award of a contract for a Phase II effort is based on the results of Phase I, the scientific and technical merit of the Phase II proposal, and the commercial potential of the proposed Phase II project. Commercial potential includes the capability to transition the technology to private sector applications, Government applications, or Government contractor applications. For the U.S. DOT SBIR Program, contracts for Phase II proposals can be funded up to \$1,500,000 (except where a lower ceiling is specifically identified) and can have a period of performance of up to 24 months from the date of contract award. The

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Government is not obligated to fund any specific Phase II proposal.

The U.S. DOT typically awards Firm-Fixed-Price (FFP), 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.

Approximately 30 days prior to the end of Phase I efforts, the U.S. DOT SBIR Program Office will provide Phase I contract awardees details on the due date, content, submission requirements, and evaluation criteria for Phase II proposals.

A summary of Phase II proposal 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>.

A Phase II awardee may receive one additional, sequential Phase II award to continue the work of an initial Phase II award.

- 2. Phase II Contract Type and Accounting System Audits.** The Contracting Officer will consider whether a FFPLOE, CPFF, or other contract type is appropriate for each Phase II award. Phase II awardees **MUST** have an accounting system that is adequate for determining costs applicable to the contract or order to receive a cost type contract.

### B. Reports

Under Phase I SBIR efforts, three (3) reports will be required, consisting of two (2) interim narrative reports, and a comprehensive final report. These reports are due 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

The SBC can invoice for three partial payments for Phase I awards based on the SBC's delivery of, and the Government's acceptance of, each report. The SBC must ensure invoices are submitted in accordance with instructions in the award document, in conjunction with or after the submission by the SBC of an acceptable report(s) as described in above Paragraph B. Invoices submitted before submission of a due report will be rejected until the Phase I awardee submits an acceptable report.

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

## D. Innovations, Inventions, and Patents

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

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 it must adhere to the terms explained in this paragraph IV.D.

If proprietary information is provided by a SBC in an offer that constitutes a trade secret, or commercial or financial information, it will be treated in confidence, to the extent permitted by law, provided the offer is clearly marked by the SBC as follows:

The following legend must appear on the title page of the offer:

"This offer contains information that shall not be disclosed outside the Federal Government and shall not be duplicated, used, or disclosed in whole or in part for any purpose other than evaluation of this offer, unless authorized by law. The Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract if award is made as a result of the submission of this offer. The information subject to these restrictions are contained on all pages of the offer except for pages [*insert page numbers or other identification of pages that contain no restricted information.*]

(End of Legend)"; and,

The following legend must appear on each page of the offer that contains information the SBC wishes to protect:

"Use or disclosure of information contained on this sheet is subject to the restriction on the title page of this 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 twenty years from the award date of the Phase I project from which the data was generated. However, effective at the conclusion of the twenty-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.

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

3. **Copyrights.** With prior written permission of the Contracting Officer, the SBC may copyright and publish (subject to and 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 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 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 efforts under the topic areas identified in this solicitation; however, cost sharing is not required nor is it a factor in evaluation of offers. Cost Sharing is not applicable to Phase I offers or awards.

### F. Profit

A profit is allowed on awards to SBCs under the U.S. DOT SBIR Program consistent with the Federal Acquisition Regulations.

### G. Joint Ventures or Limited Partnerships

Joint venture (JV) and limited partnerships are permitted to submit offer(s) to this solicitation 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 of small business concern included in this solicitation (Paragraph I.E.6). JVs must be properly registered in SAM as a JV prior to receiving an award. As this can be a time-consuming process, if offering as a JV, working with SAM to get the registration done before offer submission is highly recommended.

### H. Research and Analytical Work

1. For Phase I, a minimum of two-thirds of the research or analytical effort, measured in

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

total contract dollars using simple math, must be performed by the awardee (i.e., 66.7% of total contract cost must be for other than subcontractor/consultant costs).

2. For Phase II, a minimum of one-half of the research or analytical effort, measured in total contract dollars on costs incurred for personnel must be performed by the awardee (i.e., labor and indirect rates minus costs such as material, travel, and subcontractor/consultant).

### I. Awardee Commitments

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

- FAR: <https://www.acquisition.gov/browse/index/far>
- TAR: <https://www.acquisition.gov/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 the Government's 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.



## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

6. **Certain Telecommunications and Video Surveillance Services or Equipment.** Work performed under all SBIR efforts will require certification by an Awardee as to its use of and/or delivery of covered telecommunications equipment/services and compliance with any restrictions/prohibitions based on that certification. The offeror shall review a list of excluded parties in SAM for entities excluded from receiving federal awards for “covered telecommunication equipment or services” as specifically prohibited by Section 889 of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232).
7. **Equal Opportunity.** The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin.
8. **Equal Opportunity for Veterans.** The Contractor shall not discriminate against any qualified employee or applicant for employment because he or she is a disabled veteran, recently separated veteran, active-duty wartime or campaign badge veteran, or Armed Forces service medal veteran.
9. **Equal Opportunity for Workers with Disabilities.** The Contractor shall not discriminate against any qualified employee or applicant for employment because he or she is physically or mentally disabled.
10. **Officials Not to Benefit.** No Government official must benefit personally from the SBIR funding agreement.
11. **Gratuities.** The Government may terminate the funding agreement if any gratuity is or was offered to any representative of the Government to secure the award.
12. **Patent/Copyright Infringement.** The Contractor shall report each notice or claim of patent or copyright infringement based on the performance of the funding agreement to the SBIR Program Contracting Officer.
13. **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

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

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).

14. **Section 508 Access Board Standards.** All information and communication technology (ICT) deliverables rendered under this contract must comply with the Revised Section 508 Standards of the Rehabilitation Act and the Access Board Standards, available for viewing at <https://section508.gov/>. For purposes of Revised Section 508 compliance, the definition of ICT includes information technology and other equipment, systems, technologies, or processes, for which the principal function is the creation, manipulation, storage, display, receipt, or transmission of electronic data and information, as well as any associated content. ICT acquired by a contractor incidental to this contract shall not be required to conform to the Revised 508 Standards. Unless otherwise indicated the contractor represents by signature on this contract or order that all deliverables will comply with the Access Board Standards.
15. **Government Property.** Materials, equipment, special tooling, and special test equipment either furnished by the Government or, in a cost type contract, acquired by the contractor or fabricated by the contractor, is subject to FAR clause 52.245-1 Government Property and may also be subject to special clauses specific to certain items of property.
16. **American Made Equipment and Products.** When purchasing equipment or products under an SBIR funding agreement, purchase only American-made items whenever possible.
17. **Covid-19 Safety Protocols.** Work performed under all SBIR efforts will require compliance for contractor or subcontractor workplace locations with all guidance published by the Safer Federal Workforce Task Force (Task Force Guidance) at <https://www.saferfederalworkforce.gov/contractors/>.

## K. Additional Information

1. This solicitation reflects current planning. Although not expected, there may be inconsistencies between the information contained in the FY 2022 solicitation and the terms and conditions of any resulting SBIR contract. The terms and conditions of the contract once executed are controlling.
2. The SBC shall complete an Online Representations and Certifications Application at <https://sam.gov/content/home>. The SBC should be certified in the designated North American Industry Classification System (NAICS) code (541715) of this solicitation. The size standard of NAICS code 541715 for the SBIR program is 500 employees.

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

3. The Government may request the SBC to submit additional management, personnel, and financial information in order for the Government to consider and determine the 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 at <https://www.volpe.dot.gov/work-with-us/guidelines-unsolicited-proposal-submission>.

## V. SUBMISSION OF OFFERS

Offers must be received no later than **3:00 PM (ET) on Monday, March 7, 2022**, through the U.S. DOT's automated proposal website at [https://usg.valideval.com/teams/usdot\\_2022/signup](https://usg.valideval.com/teams/usdot_2022/signup).

Offers received after that time will be automatically rejected; no exceptions will be permitted. Please be aware that the submittal process requires answering several questions; be sure to allow ample time to complete the multi-step submittal process. Offers will not be considered received by the Government until this multi-step process is complete. Offerors are encouraged to submit their offers as early as possible.

## VI. SCIENTIFIC AND TECHNICAL INFORMATION SOURCES

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

### A. Federal Highway Administration (FHWA)

#### 22-FH1: Enforcement of Bridge Load Postings Using Nondestructive Evaluation Techniques

- National Bridge Inventory: <https://www.fhwa.dot.gov/bridge/nbi.cfm>
- Code of Federal Regulations § 650.313 Inspection Procedures: [https://www.ecfr.gov/current/title-23/chapter-I/subchapter-G/part-650/subpart-C/section-650.313#p-650.313\(c\)](https://www.ecfr.gov/current/title-23/chapter-I/subchapter-G/part-650/subpart-C/section-650.313#p-650.313(c))

#### 22-FH2: AI Video Analysis of Dilemma Zone Conflicts at Signal-Controlled Intersections

- 5G and edge computing, Verizon white paper: [https://www.verizon.com/business/solutions/5g/edge-computing/5g-and-edge-computing/?gclid=aw.ds&&gclid=EAlaIqobChMiv4Sz1u2z7wIVi5-zCh2WPA2pEAAYAiAAEgKWUPD\\_BwE](https://www.verizon.com/business/solutions/5g/edge-computing/5g-and-edge-computing/?gclid=aw.ds&&gclid=EAlaIqobChMiv4Sz1u2z7wIVi5-zCh2WPA2pEAAYAiAAEgKWUPD_BwE)
- IBM solutions for 5G and edge computing: <https://www.ibm.com/cloud/edge-computing>
- Edge computing service expands with deployments in nine U.S. cities: <https://www.traffictechanologytoday.com/news/cloud-computing/edge-computing-service-expands-with-deployments-in-nine-us-cities.html>

#### 22-FH3: Concrete Curing Quantification

- FHWA's Research, Development & Technology Annual Modal Research Plan: <https://www.transportation.gov/administrations/assistant-secretary-research-and-technology/rdt-annual-modal-research-plans>

### B. Federal Railroad Administration (FRA)

#### 22-FR1: Traction Motor Seizing Device

No references.

## 22-FR2: Locomotive-Mounted Track Safety Assurance System (LOSAS)

- Laser Triangulation for Track Change and Defect Detection: <https://railroads.dot.gov/elibrary/laser-triangulation-track-change-and-defect-detection>
- Intelligent Transportations Systems Joint Program Office (ITS JPO) website: <https://www.its.dot.gov/>
- ITS Research Automation: [https://www.its.dot.gov/research\\_areas/automation/index.htm](https://www.its.dot.gov/research_areas/automation/index.htm)
- Sensors and Sensor Fusion in Autonomous Vehicles: <https://ieeexplore.ieee.org/document/8612054>
- Sensor Fusion for Autonomous Vehicles: Strategies, Methods, and Tradeoffs | Synopsys: <https://www.youtube.com/watch?v=2Fcmh7SLPBI>

## C. Federal Transit Administration (FTA)

### 22-FT1: Reduction of Transit Bus Collisions with Other Vehicles

- National Transit Database (NTD) Data: <https://www.transit.dot.gov/ntd/ntd-data>
- FTA, Major Safety Events Data - Public Transit: <https://data.transportation.gov/Public-Transit/Major-Safety-Events/9ivb-8ae9>
- FTA’s Bus Safety Data Report 2008-2018: Summary: <https://www.transit.dot.gov/sites/fta.dot.gov/files/2021-09/Bus-Safety-Data-Report-Summary-09-23-2021.pdf>

### 22-FT2: Connecting Individuals in “Food Deserts” to Healthy Foods

- Food Insecurity and Food Deserts: How Are They Related? - Institute for Food Laws and Regulations (msu.edu): <https://www.canr.msu.edu/news/food-insecurity-and-food-deserts-how-are-they-related>
- Exploring America’s Food Deserts - The Annie E. Casey Foundation (aecf.org): <https://www.aecf.org/blog/exploring-americas-food-deserts>
- National Highway System - FHWA HEPGIS Maps (dot.gov): <https://hepgis.fhwa.dot.gov/fhwagis/>

### 22-FT3: Blockchain-Enabled Transit Incentivization

No references.

### 22-FT4: Tools and Applications Towards Moving to Zero-Emissions

- FTA’s Bus Testing Program website: <https://www.transit.dot.gov/research-innovation/bus-testing>
- Larson Transportation Institute’s Bus Research and Testing Center:

<https://www.altoonabustest.psu.edu/>

- FTA’s Transit Greenhouse Gas Emissions Estimator tool v2.0:  
<https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/ftas-transit-greenhouse-gas-emissions-estimator>

## **D. Pipeline and Hazardous Materials Safety Administration (PHMSA)**

### **22-PH1: Nondestructive, Streamlined Testing and Monitoring of Metal Cylinders and Tanks to Prevent Packaging Failure**

No references.

### **22-PH2: Autonomous Vehicle Leak Detectors**

- ASTM International *Standardization News*, “Drones Move into the Mainstream” –  
[https://www.standardizationnews.com/standardizationnews/july\\_august\\_2020/MobilePag edArticle.action?articleId=1598421#articleId1598421](https://www.standardizationnews.com/standardizationnews/july_august_2020/MobilePag edArticle.action?articleId=1598421#articleId1598421)

### **22-PH3: Vibration Sensing System to Monitor for Potential Excavation Damage**

- Pipeline Incident 20 Year Trends: <https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-incident-20-year-trends>

### **22-PH4: Underground Natural Gas Storage (UNGS) Advanced Leak Identification and Well Control Solutions**

No references.

## VII.SUBMISSION FORMS AND CERTIFICATION (APPENDICES)

A. Offer Signature Page (Appendix A)

PDF version of [Appendix A](#) (page 1 of PDF) is available on U.S. DOT's SBIR website. A sample is provided in this solicitation document.

B. Project Summary (Appendix B)

PDF Version of [Appendix B](#) (page 2 of PDF) is available on U.S. DOT's SBIR website. A sample is provided in this solicitation document.

C. Contract Pricing Worksheet (Appendix C)

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)



**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

**A. Offer Signature Page (Appendix A)**

**U.S. DEPARTMENT OF TRANSPORTATION  
SMALL BUSINESS INNOVATION RESEARCH PROGRAM  
SOLICITATION NO. 6913G622QSBIR1, FY 2022  
SIGNATURE PAGE**

Offer Information		
Topic No. (see Solicitation):	Solicitation No.: 6913G622QSBIR1	
Topic Title:		
Offer Title:		
Company Information		
Company:		
Address:		
City:	State:	Zip:

Offeror Certification	
<p>By signing below and submitting this offer in response to Solicitation No. 6913G622QSBIR1, 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 <i>et seq.</i>); (3) double damages and civil penalties under the Program Fraud Civil Remedies Act (31 U.S.C. § 3801 <i>et seq.</i>); (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 (6) other administrative penalties including termination of SBIR awards.</p>	
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. 6913G622QSBIR1 FY 2022  
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. 6913G622QSBIR1, FY 2022  
CONTRACT PRICING WORKSHEET

Appendix C can be found on our website [here](#) in Microsoft Excel 2016 format. Please fill out the spreadsheets as directed in the instructions.

Additional information about the contract pricing worksheet and its requirements can be found in the Appendix C instructions in the first two tabs of the workbook and on our FAQ page (<https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/frequently-asked-questions>).

If you have any questions regarding Appendix C not listed on our FAQ page, please submit such questions via email to:

U.S. DOT SBIR Program Office  
[dotsbir@dot.gov](mailto:dotsbir@dot.gov)

All administrative and Appendix C questions must be submitted no later than 5:00 p.m. (ET) on Tuesday, March 1, 2022. Questions received after 5:00 p.m. (ET) on March 1, 2022, may not be answered. The Government reserves the right to address a late question, if the Government determines an answer is in the best interest of the Government.

## D. Offer Submission Checklist (Appendix D)

U.S. DEPARTMENT OF TRANSPORTATION  
SMALL BUSINESS INNOVATION RESEARCH PROGRAM  
SOLICITATION NO. 6913G622QSBIR1, FY 2022  
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 II.B of this Solicitation). **Do not include this checklist with your offer.**

- \_\_\_ 1. The offer reflects that for Phase I, a minimum of two-thirds of the research or analytical effort, measured in total contract dollars using simple math, must be performed by the awardee (i.e., 66.7% of total contract cost must be for other than subcontractor/consultant costs).
- \_\_\_ 2. The offer is submitted according to the requirements described in Section II.
- \_\_\_ 3. The offer is limited to only ONE of the research topics in Section VIII.
- \_\_\_ 4. The budget may be up to \$200,000 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 (A, B, and C) have been completed.
- \_\_\_ 8. The Technical Section includes all items identified in Section II.B of the Solicitation.
- \_\_\_ 9. The additional information on prior Phase II awards, if required, in accordance with Section II.B, is included.
- \_\_\_ 10. The Contract Pricing Worksheet (Appendix C) has been completed and the Contract Pricing Worksheet Supporting Documentation file provides the necessary supporting

**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

information.

- \_\_\_\_\_ 11. The offer must be submitted online and received by the U.S. DOT automated proposal website by **3:00 p.m. (ET), March 7, 2022. Offers received via email or any other means will not be accepted. Do not send duplicate offers via email or by any other means.**

## **VIII. RESEARCH TOPICS**

The FY 2022 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 may be referenced in the respective topic descriptions.

<b>U.S. DOT Operating Administration</b>	<b>Topic Number &amp; Title</b>	<b>Estimated Award Amount Phase I*</b>	<b>Estimated Award Amount Phase II**</b>
Federal Highway Administration (FHWA)	22-FH1: Enforcement of Bridge Load Postings Using Nondestructive Evaluation Techniques	\$150,000	\$500,000
	22-FH2: AI Video Analysis of Dilemma Zone Conflicts at Signal-Controlled Intersections	\$150,000	\$1,000,000
	22-FH3: Concrete Curing Quantification	\$150,000	\$1,000,000
Federal Railroad Administration (FRA)	22-FR1: Traction Motor Seizing Device	\$200,000	\$300,000
	22-FR2: Locomotive-Mounted Track Safety Assurance System (LOSAS)	\$200,000	\$750,000
Federal Transit Administration (FTA)	22-FT1: Reduction of Transit Bus Collisions with Other Vehicles	\$200,000	\$750,000
	22-FT2: Connecting Individuals in “Food Deserts” to Healthy Foods	\$200,000	\$750,000
	22-FT3: Blockchain-Enabled Transit Incentivization	\$200,000	\$750,000
	22-FT4: Tools and Applications Towards Moving to Zero-Emissions	\$200,000	\$750,000
Pipeline and Hazardous Materials Safety Administration (PHMSA)	22-PH1: Nondestructive, Streamlined Testing and Monitoring of Metal Cylinders and Tanks to Prevent Packaging Failure	\$200,000	\$1,000,000
	22-PH2: Autonomous Vehicle Leak Detectors	\$200,000	\$1,500,000

**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

<b>U.S. DOT Operating Administration</b>	<b>Topic Number &amp; Title</b>	<b>Estimated Award Amount Phase I*</b>	<b>Estimated Award Amount Phase II**</b>
	22-PH3: Vibration Sensing System to Monitor for Potential Excavation Damage	\$150,000	\$1,000,000
	22-PH4: Underground Natural Gas Storage (UNGS) Advanced Leak Identification and Well Control Solutions	\$150,000	\$1,000,000

\* Offers 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 when instructions on the Phase II process are sent approximately 1 month prior to the end of the Phase I project.

Research topics are organized into four sections:

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

## A. Federal Highway Administration (FHWA)

*About Us:* FHWA's Research, Technology, and Evaluation Program strives to generate new solutions, build more effective partnerships, and provide better information and tools for decision making, which will enable the nation to enhance and make the best investments in the U.S. transportation system.

### **22-FH1: Enforcement of Bridge Load Postings Using Nondestructive Evaluation Techniques**

All bridges in the National Bridge Inventory<sup>1</sup> are required to have structural load ratings<sup>2</sup>. Those load ratings determine the safe load capacity of the bridge. Load ratings may indicate the need to load-restrict bridges if load ratings values are below the state-defined legal loads. In the worst cases, when overweight vehicles exceed posted load restrictions, they can cause damage to or failure of the bridge.

The lack of enforcement of these load restrictions is an issue nationwide. Most, if any, verification of actual truck weight is accomplished at fixed weigh stations. Unfortunately, bridges with load restrictions are not typically near these weigh stations.

Enforcement by the local and state law enforcement is usually very limited or non-existent because staffing and equipment are beyond the resources of the bridge owners, which may be local agencies, counties, cities, Tribal governments, states, or federal agencies.

A possible answer to this enforcement could be to install weigh-in-motion (WIM) or some other nondestructive evaluation (NDE) on the structure or in the pavement at each end of the bridge. These systems could be calibrated to be triggered to identify when the load restriction amount is exceeded. Photo enforcement or other types of enforcement could be used in conjunction with the WIM or other NDE.

Use of such a system will extend the life of the structure by reducing the number of overweight vehicles crossing it.

#### *Expected Phase I Outcomes*

Under this research, requirements should be developed for the hardware and software for a system to detect when a bridge's load restriction amount is exceeded. This system could use current WIM technology or other existing or new NDE methods. The system should be vandalism proof. A system should be developed to collect the truck weight data and truck identification information, translate the data to a usable format for non-professionals, and be able to transmit the information offsite. This information could be shared with enforcement agencies

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<sup>1</sup> <https://www.fhwa.dot.gov/bridge/nbi.cfm>

<sup>2</sup> [https://www.ecfr.gov/current/title-23/chapter-I/subchapter-G/part-650/subpart-C/section-650.313#p-650.313\(c\)](https://www.ecfr.gov/current/title-23/chapter-I/subchapter-G/part-650/subpart-C/section-650.313#p-650.313(c))



## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

in a manner similar to red-light cameras, which record the information, or it could be transmitted directly to a transportation management center or a truck size and weight enforcement office to monitor.

Additionally, a prototype of a system should be developed. A final report shall be developed that outlines the potential technical opportunities, a review of similar technologies and applications, and a proposed plan to develop, test, and explore market opportunities for the proposed innovation.

### *Expected Phase II Outcomes and Deliverables*

Further prototype development of a commercialized economical solution for states and local owners to procure, install, and implement, providing a much-needed level of safety. This prototype should be tested at remote bridge locations that currently have a load restriction to demonstrate its durability and functionality. An important criterion for the system should be that it is a low-cost solution that can be purchased and installed by any bridge owner, large or small.

## **22-FH2: AI Video Analysis of Dilemma Zone Conflicts at Signal-Controlled Intersections**

Edge computing is a resource-efficient platform that emphasizes processing data, making and executing decisions near the point (or edge) of data generation. It is well suited for time-critical and data-intensive tasks, such as processing videos from traffic surveillance cameras.

Vehicles caught in a dilemma zone—measured in traveling time/distance range to the intersection stop bar, within which about 90 percent of drivers will decide to brake whereas 10 percent of drivers will decide to accelerate at the time of phase change from green to yellow—may induce angle and rear-end crashes. Other imminent trajectory conflicts, due to sudden lane changing and unpredictable pedestrian/cyclist movements at the intersection, may also arise due to nature in traffic control or intersection geometry. Detecting such conflicts is the first step in devising countermeasures to mitigate their potential harm.

Artificial intelligence (AI)-based machine vision algorithms have become more powerful and easier to implement in analyzing real-time videos to identify objects of interest (vehicles, pedestrians, cyclists) and estimate their sizes and speeds. This project will leverage edge computing and AI in machine vision to address the critical needs of protecting road users from harmful traffic conflicts. It supports DOT's strategic goals of safety and innovation.

This project will develop an edge server-based AI application for analyzing videos from multiple cameras monitoring different approaches of intersection(s) to perform different analytics:

1. Analyze videos covering 200–600 ft. (or alternative practical distance ranges) upstream of the intersection to track vehicle behaviors such as lane changing and speeds, and determine the types (car or truck) and number of vehicles that would be caught in the

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

dilemma zone at the time of upcoming phase change from green to yellow.

2. Analyze videos covering the intersection area to identify vehicles, pedestrians, and cyclists crossing the intersection and log different types of trajectory conflicts, including vehicle-to-vehicle (V2V), vehicle-to-pedestrian (V2P), vehicle-to-bicycle (V2B), and bicycle-to-pedestrian (B2P).

The above analyses may be performed by different software applications running in parallel on the edge server. Outputs from the analyses give insights of what detected conflicts may cause severe traffic crashes, and what changes in intersection signal operation or geometry may be warranted to defuse them.

If the prototype deems successful in logging and classifying dilemma-zone-related trajectory conflicts at less than 20 percent false positive rate, it can be implemented at any 5G Internet-ready signalized intersections with video surveillance. The target customers are state DOTs, counties, and cities that operate signal intersections. U.S. DOT can also be a potential buyer of this type of product.

### Resources:

- 5G and edge computing, Verizon white paper: [https://www.verizon.com/business/solutions/5g/edge-computing/5g-and-edge-computing/?gclid=EAIAIQobChMIv4Sz1u2z7wIVi5-zCh2WPA2pEAAYAiAAEgKWUPD\\_BwE](https://www.verizon.com/business/solutions/5g/edge-computing/5g-and-edge-computing/?gclid=EAIAIQobChMIv4Sz1u2z7wIVi5-zCh2WPA2pEAAYAiAAEgKWUPD_BwE)
- IBM solutions for 5G and edge computing: <https://www.ibm.com/cloud/edge-computing>
- Edge computing service expands with deployments in nine U.S. cities: <https://www.traffictechanologytoday.com/news/cloud-computing/edge-computing-service-expands-with-deployments-in-nine-us-cities.html>

### *Expected Phase I Outcomes*

A proof-of-concept report with the following expected details:

- A conceptual design consisting of one edge server and two or more signal-controlled intersections connected to the edge server via (5G) high-speed Internet.
- The edge server can receive live updates of all signal timing decisions and live video streaming from all cameras installed at the intersections.
- Separate applications running on the edge server for analyzing videos covering upstream areas of the intersection(s) and videos covering the intersection(s).
- Include architecture design showing:
  - data generation points and data flow paths;
  - where video files are stored and processed; and
  - how analyses outputs are formatted, stored, and transferred as inputs to signal

timing decision making.

Other outcomes: Identify potential collaborating agencies that are interested in testing and implementing this type of product; identify candidate intersections that have the required data generation and data communication capabilities.

### *Expected Phase II Outcomes and Deliverables*

A prototype edge server with all developed software pre-installed. A setup module is provided to allow users to configure it to be connected to/de-coupled from any signalized intersections that meet the data generation/communication requirements. The applications on the edge server are scalable and can monitor/process videos from up to 10 or more signalized intersections. Ideally, communication between signal intersection(s) and edge server is via 5G wireless Internet, and the edge servers are nodes on wired (fiber/cable) high-speed Internet.

The analysis outputs are archived and easily retrievable by users for identifying time-of-day (and other) patterns of different types of conflicts detected.

The software has features for de-identified data collection at intersections to observe movements, and the capability of shared learning between applications that process videos from different approaches or different intersections.

## **22-FH3: Concrete Curing Quantification**

This topic seeks to evaluate the quality of concrete curing operations to maximize the performance of concrete infrastructure. State highway agencies have identified the need to ensure the quality of curing of concrete infrastructure being constructed in their programs. Good curing practices lead to fewer issues related to volume instability, cracking, and surface defects. To date, many agency specifications related to curing are prescriptive, and FHWA has observed that these prescriptive type specifications are not sufficient in cases with extreme conditions (e.g., dry conditions, high wind speeds). The challenge of applying prescriptive specifications to extreme conditions can be especially relevant in the applications that state transportation agencies typically construct, such as bridge decks and pavements.

The solution to this challenge could be a device that determines how much curing operations have prevented the loss of water to the environment. The system should be able to accurately identify moisture lost to poor curing operations versus a reduction in free water due to hydration or other reactions present in cement-based systems. The idea is that the device would collect and store data points at a frequent enough interval that could inform ongoing construction practices. The system would utilize an interface (cloud-based or on-board the device itself) that would allow a contractor and ultimately an agency to assess the quality of curing operations. The expectation is that the data points, or some other characteristic of the data (e.g., the rate of change of the data), could be used to establish quantifiable thresholds with data taken

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

automatically for an agency to ensure compliance with its specifications.

The proposed solution supports FHWA's Annual Modal Research Plan (AMRP)<sup>3</sup> by developing and enhancing tests and processes related to the performance-engineered mixtures (PEM) initiative for concrete pavements. It will also contribute to the Department's strategic objective of improving the performance of the Nation's infrastructure. This can be achieved through research and accelerating development and deployment of innovative technologies and practices by the continued refinement of techniques of accurately assessing the durability of concrete pavements and structures.

The opportunity for commercialization in the U.S. is extremely high. Many public agencies build concrete infrastructure with large, exposed surface areas susceptible to evaporation where curing processes are critical to ensuring good performance.

Overall, this SBIR topic seeks to create a device that could be embedded into a concrete element and determine the quality of curing that the concrete experiences after placement. The device should be able to take regular measurements that can be used by a contractor to make decisions about curing and by an agency to assess curing. If needed, the post-processing of the data to analyze measurements should be limited to that which could be implemented in a spreadsheet or be conducted by a workforce with skills similar to that of an American Concrete Institute (ACI) certified field technician. Specific stakeholders who could be involved in the evaluation and testing phase include the FHWA Office of Infrastructure R&D, one or more progressive state highway agencies, and academic institutions that are interested in implementing this technology.

### *Expected Phase I Outcomes*

The Phase I project is expected to result in a proof-of-concept report that describes the evaluation of the different techniques proposed for the system, the detailed scientific basis for the operation of the system, and a description of the proposed prototype(s). The report should include an estimated timeline for the prototype(s) production, evaluation, and accuracy verification. The Phase I report should present an estimated market size of the final prototype, discuss critical opportunities and obstacles to implementation, and illustrate a practical and tentative plan for verification and demonstration to be conducted in Phase II.

### *Expected Phase II Outcomes and Deliverables*

Phase II will include the development and demonstration of a market-ready prototype for user testing and possible commercialization. Phase II should further refine the concept, design, and fabrication of the prototype(s) and conduct analytical and experimental verification. The experimental verification will include verification with a wide range of concrete mixture types (e.g., paving, structural bridge deck, pre-cast) and environments (e.g., dry, humid, high wind,

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<sup>3</sup> <https://www.transportation.gov/administrations/assistant-secretary-research-and-technology/rdt-annual-modal-research-plans>

**U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

hot, cold) to increase the likelihood of effective implementation. Another final outcome is the delivery of at least two final prototype units to FHWA for evaluation on shadow projects with owner agencies.

## B. Federal Railroad Administration (FRA)

*About Us:* FRA's research, development, and technology (RD&T) mission is to ensure the safe, efficient, and reliable movement of people and goods by rail through basic and applied research, and development of innovations and solutions. Safety is U.S. DOT's primary strategic goal and thus, the principal driver of FRA's RD&T program. FRA's RD&T program also contributes to other U.S. DOT strategic goals because safety-focused projects typically yield solutions toward state of good repair, economic competitiveness, and environmental sustainability goals. The RD&T program also has an important role to play in workforce development.

FRA's RD&T program is founded on an understanding of safety risks in the industry. Hazard identification and risk analysis allows us to identify opportunities to reduce the likelihood of accidents and incidents, and to limit the consequences of hazardous events should they occur. Key strategies include stakeholder engagement and partnerships with other researchers such as the Association of American Railroads, prioritization of projects, and conducting research through cost-effective procurement.

### **22-FR1: Traction Motor Seizing Device**

Traction motors on locomotives tend to seize on a weekly basis on most major freight railroads in the U.S. When this occurs, the train must be stopped to remedy the non-rotating wheel and avoid damage to the rails (or the axle would have to be "dragged" into the nearest siding). One remedy is to jack the affected truck onto a dolly and relocate it nearby where it can be repaired without disturbing revenue service. Commercially available dollies can be carried to the site in pieces. However, they weigh about 150 pounds each and require multiple people to assemble and install. Once on the dolly, the locomotive can be off the mainline, but the train's speed is limited as well as the number of miles (as little as 10) that the dolly can travel while supporting the affected truck. The weight and travel speed limitations created by a dolly are problematic in remote regions, where the responding crew is often a single technician and the distance to a suitable location for removing the pinion can be many miles away. Another option for repairing a seized traction motor would be accessing the gear box from below using a torch or thermal lance, which exposes the technician to other risks as well as danger from adjacent traffic. A safer more efficient solution is being sought to unseize traction motors on locomotives.

#### *Expected Phase I Outcomes*

The Phase I project is expected to result in a proof-of-concept report that describes a safer, more efficient solution for unseizing traction motors on locomotives and includes a stand-alone proof of concept design. The report should address system performance and industry need, use, costs, and design improvements.

#### *Expected Phase II Outcomes and Deliverables*

The Phase II project is expected to result in the development of a prototype for evaluation and

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

testing leading to commercialization. Prototype development should include testing for usability and safety evaluations to ensure the technicians' safety. Important criteria for the solution are that the prototype can be used in a time-efficient and safe manner, and that it is a functional and feasible solution. Ease of use is important. Documentation should discuss ways to enter the gear box opening and access the pinion shaft, and use of the system whether the gear case is removed or not.

### **22-FR2: Locomotive-Mounted Track Safety Assurance System (LOSAS)**

This research challenge is to develop a high-performing sensor suite and associated processing algorithms to advance the state-of-the-art in railroad locomotive-mounted systems for general situational awareness, ground hazard detection, track inspection, bridge inspection, and similar operational and track safety objectives. The goal is to maximize the utility of the locomotive platform (locomotives lead every train) to assess the safety of the track system. Systems developed under this topic will not interface with any locomotive controls or Positive Train Control system during the early phases of development. This research and development activity supports DOT strategic priorities State of Good Repair and Innovation. In addition, this effort will support recent initiatives towards advancing the application of intelligent transportation systems in the rail industry.

Many thousands of locomotives are currently equipped with forward-facing video recorders that provide valuable situational awareness data to rail operators. This topic seeks to create a more comprehensive data collection system by leveraging advancements in sensors and algorithms that are in development and testing in the autonomous automotive vehicle industry, and other areas. The solution could be a replacement for the existing forward-looking video systems, or an additional locomotive system. It is envisioned that a mature and useful system will employ a suite of sensors and fuse these sensor outputs to create information reports that provide valuable safety data to railroad operations, maintenance, and planning stakeholders. In addition, such a system may help support autonomous train operation.

The system should have the following basic characteristics:

- Robust and reliable, suitable for mounting on the exterior of a locomotive and for continuous duty (when the locomotive is moving)
- Autonomous, unattended operation
- Automatic data transfer via cellular, satellite, or other means not requiring human intervention
- All-weather functionality
- Precise data geo-location

The types of sensors and data collected are left up to the designers, but the most useful system will be sensitive to railroad track operational safety issues. The following examples are supplied

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

for information only. Many of these data could be used for defect or hazard detection (immediate issue reporting) and for change detection purposes (reporting how conditions are changing over time by comparing data from repeated runs over the same track).

- Ground hazard identification – Landslides, wash outs, significant ballast deterioration, floods, drain blockage, fallen trees, etc. Issues that are related to the geography, weather, and other natural phenomena that may affect operational safety.
- Track and bridge inspection – Rail breaks; missing fasteners, including broken and displaced spikes, clips, insulators, tie plates, joint bars, etc.; crosstie damage or displacement; low ballast levels; displacement of track relative to fixed references; track and bridge clearances; missing equipment; plate cutting; gaps between ballast and ties, etc.
- General situational awareness – Obstacles in track or other areas of the right-of-way that may affect operational safety. Application to first-pass train operations to ensure the track system is ready for revenue service.

The commercialization potential for this solution is limited only by the number of locomotives that exist worldwide. The railroad industry is embracing autonomous inspection technology at all levels of the industry. The envisioned system should have widespread appeal if pricing and performance targets are reasonable and useful.

### Sources:

- <https://railroads.dot.gov/elibrary/laser-triangulation-track-change-and-defect-detection>
- <https://www.its.dot.gov/>
- [https://www.its.dot.gov/research\\_areas/automation/index.htm](https://www.its.dot.gov/research_areas/automation/index.htm)
- <https://ieeexplore.ieee.org/document/8612054>
- <https://www.youtube.com/watch?v=2Fcmh7SLPBI>

### *Expected Phase I Outcomes*

Phase I outcomes include a proof-of-concept report which should provide a detailed description of the performance requirements, preliminary system designs, sensor identification, software requirements, and results of simulations or other activities to demonstrate that the requirements for the locomotive-mounted track safety assurance system are realistic and attainable.

### *Expected Phase II Outcomes and Deliverables*

Phase II outcomes include progressing the technology through laboratory and early field testing to demonstrate the efficacy of the design and the usefulness of the system outputs for general situational awareness, ground hazard detection, track inspection, bridge inspection, and similar operational and track safety objectives. Partnerships with a railroad operator(s) during Phase II



## **U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM**

prototype development is strongly encouraged to help the research team better understand the needs of the end-users. In addition to delivering a near-market-ready prototype, the research team will draft a comprehensive Phase II report that will capture the details of the design, development, and testing of the prototype.

## C. Federal Transit Administration (FTA)

*About us:* The Federal Transit Administration's (FTA) mission is to improve public transportation in America's communities. In support of this mission, FTA's research vision is to advance public transportation by accelerating innovation that improves mobility, enhances transit operations, and ensures safety for all. The goal of FTA's SBIR program is to help small businesses grow by funding product development research in strategic areas such as safety, infrastructure, mobility, and other topics important to transit. The program helps invest in promising early-stage innovations that may otherwise be too high of a risk for private investors.

### **22-FT1: Reduction of Transit Bus Collisions with Other Vehicles**

Transit bus collisions with privately-operated motor vehicles (POV) in large, urban areas have been the number one source of bus transit fatalities from 2008 to 2020, based on National Transit Database<sup>4</sup> (NTD) data. Almost half of all bus transit fatalities and almost half of all bus transit injuries are the result of bus collisions with POVs. As indicated in FTA's 2021 Bus Safety Data Report,<sup>5</sup> the majority of fatality victims were the passengers in the POVs. This type of collision is also the leading source of bus transit injuries; the majority of the injured were passengers on transit buses.

This research challenge is to identify the leading causal factors that contribute to this type of transit bus collision fatality and/or injury and propose mitigation strategies to reduce the incidences of fatalities and/or injuries that result from transit bus collisions with privately-operated motor vehicles. The applicant must research past collision investigations and identify the leading hazards and/or contributing factors that caused the collision fatalities and/or injuries, and then propose effective mitigations that would reduce the occurrences of these collision fatalities and/or injuries or identify solutions that address the leading contributing factors. This research aligns with DOT's and FTA's Safety priority.

FTA requires detailed safety event reporting from large bus transit agencies. These large agencies are required to provide the NTD with detailed reports of each bus collision that results in a fatality within 30 days of the event. Large agencies are also required to submit detailed reports when an event results in injuries requiring immediate transportation for medical attention for two or more people. In addition, transit agencies, insurance pools, and state and regional organizations perform investigations after bus collisions and may share relevant data on causal and contributing factors.

All types of solutions are welcomed, and offerors are encouraged to learn from transit agencies to inform root causes, which can lead to their innovative solutions. Creative thinking is encouraged in the proposed solutions, which could include engineering solutions, improved

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<sup>4</sup> <https://www.transit.dot.gov/ntd/ntd-data>

<sup>5</sup> <https://www.transit.dot.gov/sites/fta.dot.gov/files/2021-09/Bus-Safety-Data-Report-Summary-09-23-2021.pdf>

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

training solutions, or fatigue management solutions. Options could also include a way to reduce the number of bus passenger injuries, or ways to reduce fatalities in POVs through full re-design or retrofits of the bus equipment. Proposed solutions or mitigations may involve different strategies, such as developing an innovative training program, compiling an effective best practices guide, or developing a strategy to “engineer-out” the associated hazards and risks through revised specifications for new bus design or new or modified parts for retrofits.

Proposed mitigations involving an engineering solution could involve designs for retrofits or new bus design in which a proof of concept for a collision fatality and/or injury reduction method should be presented based on the findings.

As an example, if one leading contributing factor of the occurrence of the collisions was that transit bus operators did not see the vehicles, solutions such as lane-assist, improved positioning of bus mirrors, or other measures that could help reduce the occurrences could be an area where further development and testing would be required. Bus agencies would be interested in purchasing effective modifications to buses or newly designed buses with built-in features that would reduce the likelihood of these collisions. It is possible that artificial intelligence could assist in reducing the number of collisions, but this is unknown until the leading contributors of these collisions are identified.

### *Expected Phase I Outcomes*

The Phase I outcome includes a proof-of-concept report that contains research on collision investigations, classifications of the different root causes of transit bus collisions with non-transit vehicles, and identification of the hazards and/or known contributing factors that led to the collisions, with a ranking of the leading hazards and/or contributing factors.

identification of any specific hazards that led to the fatalities as a result of the collisions and/or the specific hazards that led to the injuries on the bus.

The report should include proposed methods or strategies for addressing the contributing factors and/or specific hazards identified through the research. This may include ideas for developing prototypes, if not possible prototype design(s), and general cost estimates for developing prototypes for testing.

If a transit partner(s) is already known, identify potential partnership with one or more urban bus agencies to test proposed mitigations—e.g., training modules, retrofitted bus equipment, specifications for future procurements.

### *Expected Phase II Outcomes and Deliverables*

Expected Phase II outcomes include prototype development and testing. Testing will require a partnership with at least one urban bus transit agency. (Note: The recently passed Bipartisan Infrastructure Law includes funding for testing by bus operators to reduce visibility

impairments.) The testing phase would require monitoring the effectiveness of the mitigations.

If the program requires transit bus operators to drive modified or new bus equipment, analysis from the pilot should consider feedback from operators regarding the effectiveness of the desired improvements.

If the program requires improved training curriculum and methods, testing prior to and after the training would be used to measure its effectiveness. Monitoring the number of bus collisions with POVs and/or the number of resulting fatalities and/or injuries over a defined period of time would assist in identifying improvements to the proposed mitigations/solutions and support determinations as to the effectiveness of the mitigation efforts.

## **22-FT2: Connecting Individuals in “Food Deserts” to Healthy Foods**

“The U.S. Department of Agriculture defines food deserts as areas where people live more than 1 mile from the impact of a supermarket in urban areas, or 10 miles away in rural areas.”<sup>6</sup> Barriers to accessing grocery stores and healthy food choices is a reality in many low-income communities, creating many “food deserts” in the inner city, as well as rural areas.

The goal of this research topic is to address: How can improved connections to mobility options be used to reduce food deserts and provide options for all individuals to access affordable and quality groceries and healthy food? Various forms of technological solutions can be used to help individuals access grocery stores and healthy food choices through public transportation, shared rides, or other forms of mobility.

This subject is related to an important element of the Department of Transportation’s (DOT) Goals, Strategic Objectives, and Strategies. One of DOT’s Infrastructure goals has a Strategic Objective of “Project Delivery, Planning, Environment, Funding and Finance,” with the strategy of “[building] partnerships with stakeholders to facilitate the financing, development, and implementation of multimodal transportation projects that improve connectivity, accessibility, safety, and convenience for all users.”

Commercialization of potential technological solutions can be made through an app, technological software, or some other form of information-sharing downloaded to smartphones, tablets, and/or computers.

Technology ownership should not be a barrier; if an individual does not own or have personal access to technological tools, then access to these items may be available through community gathering activity centers such as religious organizations, education institutions (K to post-graduate), community centers, libraries, etc. A consideration to be applied to this research topic is to provide options for connecting individuals without access to technology to these community

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<sup>6</sup> “Food Insecurity and Food Deserts: How Are They Related?” Institute for Food Laws and Regulations: <https://www.canr.msu.edu/news/food-insecurity-and-food-deserts-how-are-they-related>

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

resources. The ability to access this information can provide the initial step towards accessing healthy foods.

The proposed research will develop a technological solution that can provide access by connecting individuals to public transit resources, as well as to public transit, to decrease the impact of food deserts and increase access to healthy food options in low-income areas located in inner cities and suburban/rural areas.

Some resources regarding food deserts and food insecurity include, but are not limited to:

- Food Insecurity and Food Deserts: How Are They Related? - Institute for Food Laws and Regulations (msu.edu): <https://www.canr.msu.edu/news/food-insecurity-and-food-deserts-how-are-they-related>
- Exploring America's Food Deserts - The Annie E. Casey Foundation (aecf.org): <https://www.aecf.org/blog/exploring-americas-food-deserts>
- National Highway System - FHWA HEPGIS Maps (dot.gov): <https://hepgis.fhwa.dot.gov/fhwagis/>

### *Expected Phase I Outcomes*

Phase I outcomes include a proof-of-concept report which contains a literature review on the major transportation barriers to accessing healthy foods, and potential solutions that utilize public transit resources to mitigate food deserts. The report should also identify the recommended technology solution that mitigates food deserts through access to public transportation. The approach should identify two or three communities where a prototype design or model could be implemented as a pilot in Phase II.

### *Expected Phase II Outcomes and Deliverables*

Develop a prototype based on the concept of operations and pilot test the solution. The technological solution (i.e., tool) should be easy to use and access by the public through personal technology equipment and/or public centers such as libraries, community centers, etc. Additionally, the tool should be easy for transit agencies to implement/incorporate with their existing technology platforms.

## **22-FT3: Blockchain-Enabled Transit Incentivization**

The emergence of blockchain technology has been highlighted over the past few years for the new and promising innovations the technology enables. The impact of blockchain, such as secure digital transactions, is rapidly growing and manifesting itself in many ways, including how people interact and pay for services, how transactions are secured and verified, and how scarce resources are managed and mobilized.

This proposed SBIR research, blockchain-enabled transit incentivization, will include the

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

development of an operational concept to determine the feasibility and effectiveness of novel incentivization strategies using blockchain technology, such as a tokenized gamification through a smart phone application, to manage modality use by commuters.

As more employees return to offices and worksites, there will be fewer available parking spaces than demanded by commuters in many large employment locations. This potential scarcity of shared parking resources, as well as the uncertainty of finding an open space without coordination, presents an opportunity to influence commuters' decisions in real time. A novel strategy utilizing blockchain technology would provide a dynamic approach to incentivizing alternatives to driving. For instance, travelers can spend tokens to reserve a parking space or receive tokens for agreeing to use a different mode of transportation. As spaces are reserved and become scarcer, the system may offer increasing incentives, or tokens, for travelers to choose not to reserve a space or to take a different mode, such as public transportation and other shared mobility options. Blockchain technology could facilitate tracked, trusted payment transactions and provide verification to ensure that users can access a reserved parking space or earned incentives. Moreover, the use of blockchain technology could ensure real-time, transparent information on incentives to travelers; provide secure decentralized management of tokens and guarantee the credibility of data; enable the use of novel gamification strategies amongst users as a further incentive; and facilitate the coordination and scaling of the system to multiple facilities.

This research aligns with DOT's and FTA's Transformation/Equitable and Accessible Mobility goals. Active management and incentivization of travel options allows more efficient use of transportation resources, provides dynamic coordination of a range of mobility solutions, and can enhance how transit agencies and communities coordinate and operate transportation services that are focused on enhancing traveler mobility and promoting equity, while considering climate impacts. Blockchain-enabled transit incentivization tools could potentially include individualized, curated incentives that incorporate equity considerations, with incentives promoted to individual users based on their location as well as personal circumstances.

Commercialization potential includes operators of public transit systems, who could use the blockchain model to promote mobility management practices for their own parking resources, or partnerships with local employers to promote transit-based mobility options in their service area. Similarly, commercialization potential also exists for state and local entities that want to incentivize transit and other mobility alternatives and manage scarce parking or curbside resources. Longer-term commercialization potential includes private entities, such as commercial buildings, employers, or universities that may adopt the technology to dynamically manage scarce parking resources and incentivize mobility alternatives to ensure maximum public access to their site.

### *Expected Phase I Outcomes*

In Phase I, the expected outcome is a proof-of-concept report that presents an operational

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

concept for the blockchain-enabled transit incentivization—initially a smart-phone-based app supported by a custom private blockchain set up to manage the pilot (if funded for Phase II). The report should also identify candidate testing locations (up to three) where a prototype is embraced and beneficial to both the employers and the employees.

### *Expected Phase II Outcomes and Deliverables*

Phase II outcomes will include the development of a prototype app for blockchain-enabled transit incentivization in partnership with a major employer or community for a pilot program, and the collection of key data about the viability of gamification in transit incentivization using blockchain. A pilot program is not a requirement of Phase II, but if done, a controlled pilot deployment is preferred to collect data on the effectiveness of the approach.

## **22-FT4: Tools and Applications Towards Moving to Zero-Emissions**

Moving to zero-emissions transit fleets requires public transit agencies to rethink and retool maintenance systems and bus routes and build out new charging infrastructure. In many cases, these changes will also require organizational structure shifts, worker retraining/reskilling, and new tools and applications to help transit agencies transition to zero-emission fleets. Decisions around bus models and fuel types must accommodate the unique climate, terrain, service hours, and route length for each transit agency's operations. However, not all transit agencies have the resources or the expertise to research and analyze what options would be best for them.

This proposed research would explore the creation of a tool or application that can help transit agencies select the right battery electric bus for their unique systems—taking into consideration terrain, climate, length of route, etc.—and to create models to predict the greenhouse gas (GHG) emission impacts of this change in transportation type. The emissions models could be part of the tool or application or could be separate from it. This research aligns with DOT's and FTA's Climate and Sustainability and Environmentally Sustainable Systems priorities.

Transit agencies would be the main customer of a commercialized tool or application to use to help them make more informed choices about battery electric bus purchases. DOT would not be a customer since transit agencies make purchasing decisions on their own. FTA publishes the bus testing reports for each bus model tested but does not direct purchasing decisions. This tool would help transit agencies make decisions about which buses to purchase and help move the nationwide transit bus fleet towards zero emissions.

FTA's Bus Testing program website can be found here: <https://www.transit.dot.gov/research-innovation/bus-testing>

The Bus Testing Report database can be found here: <https://www.altoonabustest.psu.edu/>

FTA's Transit Greenhouse Gas Emissions Estimator tool can be found here: <https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/ftas-transit->

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

### [greenhouse-gas-emissions-estimator](#)

#### *Expected Phase I Outcomes*

The Phase I proof-of-concept report should describe the methods and results of a feasibility study to identify the potential solution to develop, prototype, and test a tool or application that can help transit agencies make decisions regarding which electric bus model(s) to purchase based on their geographic needs and characteristics (e.g., distance per charge, peak vs. non-peak, gravel vs. smooth roads, steep/grade inclination, urban vs. rural).

#### *Expected Phase II Outcomes and Deliverables*

Phase II outcomes include the development of a market-ready prototype that can be deployed in a variety of zero-emissions fleet transition types and market for large, small, and rural transit agencies. The prototype should include integration of transit emissions information to create models to predict the GHG emission reduction of transit fleets for future planning/funding/policy purposes for such transit agencies.



## **D. Pipeline and Hazardous Materials Safety Administration (PHMSA)**

*About Us:* 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 Pipeline Safety Research Program sponsors research and development projects focused on providing near-term solutions for the U.S.'s pipeline transportation system that will improve safety, reduce environmental impact, and enhance reliability. This includes ensuring that PHMSA's R&D program implements the Administration's priorities through R&D investments that promote safety and environmental protection, climate change, economic recovery and rebuilding, and transportation as an engine for equity.

Recent R&D projects are focused on leak detection; detection of mechanical damage; damage prevention; improved pipeline system controls, monitoring, and operations; and improvements in pipeline materials. These projects are addressing technological solutions that can quickly be implemented to improve pipeline safety and limit environmental impact of PHMSA-regulated infrastructure.

PHMSA's Office of Hazardous Material Safety regulates the transportation of hazardous materials by air, rail, highway, and water. Over 1.3 million hazardous material products are transported daily over the various transportation modes. Because of the ubiquity of hazardous material movements, supporting the safe transport of these products will have a positive impact on safety and performance. The Office of Hazardous Material Safety seeks to improve the safety and reliability of hazardous material transportation.

### **22-PH1: Nondestructive, Streamlined Testing and Monitoring of Metal Cylinders and Tanks to Prevent Packaging Failure**

Recertifying cylinders and tanks is a costly and time-consuming process that ensures a minimum level of safety for the transportation of hazardous materials. During operation and in between recertifications, cylinders and tanks can encounter a variety of chemical and physical stresses that can accelerate package failure. The early identification of packages that have experienced excessive physical strain and are susceptible to rupture or chemical interaction that causes embrittlement may prevent catastrophic failures from occurring in unsafe manners.

Live and continuous monitoring or rapid checkpoints for inspection use technology such as high-frequency sound modulators or metrology in fiber optics coupled with software to rapidly identify defects. This research topic seeks a technology for nondestructive testing and monitoring of metal cylinders and tanks to prevent packaging failure, which may include the use of ultrasound, fiber optics, or a combination of both, with identified and recommended needs for checkpoint versus continuous monitoring. This approach may provide an equivalent or greater level of safety than current inspection practices while also reducing the need to pull packages out

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

of circulation for inspections and recertification.

To be commercialized, the technology must be accessible and capable of being directly integrated into new packagings or built to be compatible with existing form factors. Customers transporting contents under pressure or bulk hazardous materials in tanks cover fuel, petrochemical, and specialized gas industries.

### *Expected Phase I Outcomes*

The Phase I proof-of-concept report should include details on the recommended technology and requirements.

The report should also provide information on estimated cost savings, incident reductions, and new methodology for measuring packaging performance that is in compliance with regulations or may be used to develop new regulations/policies.

### *Expected Phase II Outcomes and Deliverables*

Phase II will include the fabrication of a prototype device or package to be used. Testing will include data collection from testing of the prototype that may be used to identify criteria for new performance-based regulations. Utilizing a testing phase with a small group of users would help ensure effectiveness and user input. Commercialization plans should also consider the optimization required for implementation and distribution into market.

## **22-PH2: Autonomous Vehicle Leak Detectors**

A recent cover article in ASTM International's *Standardization News* proclaimed, "Drones Move into the Mainstream."<sup>7</sup> Automation in transportation, particularly in the arena of automated delivery vehicles, is currently a very hot topic with many potential applications. Using autonomous delivery vehicles for hazardous material transportation could improve safety, as no individual would be in the immediate vicinity of the hazard in case of accidental release. While there are obvious advantages to removing humans from the delivery of hazardous materials, there are still numerous obstacles to overcome on the path to realization of hazardous goods transport via autonomous vehicles.

One of the significant obstacles is the lack of in-situ leak detection. Currently, the driver or pilot of the hazardous cargo can detect leaks either by on-board sensors or by simply recognizing the leak. In an autonomous shipment, this would be impossible without accurate and reliable leak detectors. The detectors would be required to work in varied environmental conditions, sense multiple or specified materials, and communicate remotely with first responders and/or shippers

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[https://www.standardizationnews.com/standardizationnews/july\\_august\\_2020/MobilePagedArticle.action?articleId=1598421#articleId1598421](https://www.standardizationnews.com/standardizationnews/july_august_2020/MobilePagedArticle.action?articleId=1598421#articleId1598421)

to allow mitigation of the problem.

PHMSA is seeking prototype, remotely operated leak detectors. The detectors must be broadband detectors or tunable to specific compounds. They must be able to communicate with a central processing station and report leaks to the appropriate authorities. System redundancy is also requested.

#### *Expected Phase I Outcomes*

Phase I will include a proof-of-concept report that details the process for identifying the recommended solution and includes specification requirements and design options for the leak detection prototype to be developed in Phase II.

#### *Expected Phase II Outcomes and Deliverables*

Phase II will result in a prototype of the leak detector with lab or field testing to demonstrate its effectiveness.

### **22-PH3: Vibration Sensing System to Monitor for Potential Excavation Damage**

Approximately 22 percent of serious incidents in PHMSA's regulated pipeline operations are caused by excavation damage.<sup>8</sup> In an effort to limit harm to the public and environment from excavation, additional solutions should be developed to monitor for imminent risks. PHMSA is seeking the development of new or improved technology systems to monitor for and detect vibrations from excavation damage threats (e.g., excavation activities for new utility installation in close proximity to pipelines) and notify the pipeline operator via appropriate means.

In partnership with the new technology provider, pipeline operators would install this solution permanently onto the pipeline in the ground. This solution would likely utilize existing fiber optic sensing systems and would include the appropriate algorithm to interpolate the data and determine methods to connect the fiber optic cables to the pipeline. Some fiber optic technologies on the market may already have the ability or at least potential for capabilities to detect vibrations, but additional research may be needed to improve or more fully test the systems in pipeline operations. Furthermore, this solution would need to account for the legacy nature of distribution pipeline networks, which do not include a network infrastructure to tap into.

Pipeline operators would be able to compare the excavation alert from this new system to active one-call tickets to determine if digging is scheduled or if it is an unauthorized digging activity. The solution should model different threats and non-threats in order to limit false negatives. The

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<sup>8</sup> Calculation based on an analysis of PHMSA's dataset at <https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-incident-20-year-trends>.

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

notification system should account for the lack of disbursed network technology in distribution natural gas pipelines.

This R&D project would fall under PHMSA's threat prevention programmatic element. Potential buyers of this solution would include oil and natural gas pipeline companies. The solution may also be applicable to other underground utilities.

### *Expected Phase I Outcomes*

Phase I will result in a proof-of-concept report outlining the feasibility of the vibration sensing system. The report should detail the design and requirements for the prototype and modeling results tied to the sensing notification system. A prototype of the system, or mock-up of it, is expected at the end of Phase I.

### *Expected Phase II Outcomes and Deliverables*

Phase II should include two deliverables, the first being a functional prototype, and the second being a full-scale test of the system proving its capability to industry partners. PHMSA should be provided with a report outlining the full-scale testing of the system, as well as a path forward for commercialization.

## **22-PH4: Underground Natural Gas Storage (UNGS) Advanced Leak Identification and Well Control Solutions**

In October of 2015, a leak was discovered on an Underground Natural Gas Storage (UNGS) well near Aliso Canyon, California. The operator attempted to control the well multiple times through top-kill efforts. Meanwhile, the operator started to drill a relief well which would be utilized to intersect the leaking well, and pump fluids down at the bottom of the leaking well to seal it. During the eighth attempt, more than four months following the leak, utilizing the relief well was deemed successful and controlled the well failure. The natural gas leak led to the temporary relocation of more than 8,000 households as well as children from two schools. The incident resulted in the estimated release of 4.62 billion cubic feet of natural gas.

PHMSA recognizes the criticality of UNGS systems to the nation's energy infrastructure and is statutorily charged with ensuring the safe operation of these facilities. PHMSA is interested in research to improve safety in the full life cycle of UNGS facilities to include emergency response.

PHMSA is seeking solutions to aid UNGS facilities in identifying leaks and controlling well blow-outs/rupture failures. A successful proposal would offer technology solutions to identify leaks and control well blow-outs within a short time span, thereby limiting the risk to public safety and the environment. The well control methods should, however, not impact the continued viability of the storage facility.

## U.S. DOT SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH PROGRAM

This solution would be a two-tiered system—the first tier being a system to identify leaks, which would include sensors and an interpolation package to determine if a leak or blow-out is occurring. The second tier is a system to quickly mitigate the blow-out. Currently, operators rely on “well-kill” attempts where operators attempt to pump heavy fluids down the well to stop the release. PHMSA is seeking a solution that could expeditiously stop the release through a technology solution.

This R&D project would fall under PHMSA’s Underground Natural Gas Storage (UNGS) programmatic element. Potential buyers of this solution would include UNGS operators and entities specializing in response to well blowouts.

### *Expected Phase I Outcomes*

The Phase I proof-of-concept report will outline the feasibility of an advanced leak identification and well control system. The report should discuss the prototype design and requirements, and potential opportunities for a Phase II project.

### *Expected Phase II Outcomes and Deliverables*

Phase II should culminate in a functional system ready for commercialization. PHMSA should be provided with a report outlining the full-scale testing of the system, as well as a path forward for commercialization.