U.S. Department of Transportation

Small Business Innovation Research (SBIR) Program

FY 2026 PHASE I PROGRAM SOLICITATION

Solicitation #: 6913G626QSBIR1
Issue Date: June 3, 2026
Closing Date: July 7, 2026, 3:00 p.m. ET

Small Business Innovation Research (SBIR) Program
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)
220 Binney Street
Cambridge, MA 02142-1093

IMPORTANT INFORMATION

This Solicitation is for Phase I ONLY

Key Dates

Date	Description
June 3, 2026	Solicitation Open Date
June 3, 2026	Pre-solicitation Questions & Answers (Q&A) available
June 9, 2026, 5:00 p.m. ET	Registration Deadline for Solicitation Webinar
June 10, 2026, 1:00 p.m. ET	Solicitation Webinar
June 30, 2026, 3:00 p.m. ET	Administrative Questions Due
July 7, 2026, 3:00 p.m. ET	Solicitation Closing / Proposal Submissions Due

Amendments to Topics

The proposed topic list shared during the pre-solicitation has been amended for the U.S. DOT FY26 Phase I Solicitation as follows:

- **Topic 26-FH1:** Edge AI-V2X Integrated Practical Solutions for Congestion Prevention and Mitigation, has been updated with clarifications on what the topic seeks to develop including more specifics on expected functionalities, desired outcomes, and expectations for the Phase I final report. Additional details are also provided for the Phase II desired outcomes.
- **Topic 26-FH2:** Automated Mobile Catch-basin Inspection System, has been updated with clarifications in the Topic Description.
- **Topic 26-FR1**: Mobile High-Power Emergency BESS De-energizer System for Rail Vehicle Propulsion, has provided additional information on the battery energy storage systems (BESS) and additional details on the operational goals for the system to be developed.
- **Topic 26-FT1:** Person-Centered, Carefree, Complete Trip Planning - Powered by AI, has added detail to clarify the desired outcomes of Phase I.
- **Topic 26-OS2:** Freight Corridor Predictive Intelligence, has updated the overarching objectives, provided additional details in the technical parameters, and clarified the desired outcomes and expectations for Phase I.
- **Topic 26-PH1**: Increase End-of-Life Battery Safety and Recovery of Rare Earth Minerals, has added details to clarify the desired outcomes of Phase I.

Solicitation Webinar

Come learn about the U.S. DOT's SBIR program and this year's solicitation on Wednesday, June 10, 2026, at 1:00 p.m. ET. If you plan to submit a proposal, we encourage you to attend. The webinar will only be offered virtually to enable the broadest participation. We will address administrative questions during the webinar. No technical questions regarding the research topics will be accepted or addressed. 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).

To register, visit: https://usdot.zoomgov.com/webinar/register/WN_VMthqZz_T-eWL2oQBbbANA. The registration deadline for the webinar is Tuesday, June 9, 2026, at 5:00 p.m. ET.

Solicitation Closing Date

Complete proposal packages must be received no later than **Tuesday, July 7, 2026, at 3:00 p.m. ET.** Late proposals will not be accepted.

Submission System

All proposal packages must be submitted using U.S. DOT's SBIR automated submission system at: https://usg.valideval.com/teams/usdot_2026/signup

Notable Changes and Highlights for 2026

SBIR Program Reauthorization

The Small Business Innovation and Economic Security Act (P.L. 119-83) reauthorizes the program through September 30, 2031. Read the statute to learn about new requirements related to foreign risk and Technical and Business Assistance (TABA) among other updates.

Submitting Proof of System of Award Management (SAM) and SBIR Company Registrations moving to Appendices A & B PDF

In prior years, proof of SAM and SBIR Company Registrations were included with the Technical Section of your proposal submission. This year, ***the proof of registration for both SAM and the SBIR Company Registry must be included with the Appendices A & B upload of your proposal submission***. See section 3.3.2 for additional instructions.

Please note that SBA has updated its login procedure which may require extra time (see section 2.2). Please allow ample time for both registrations.

Disclosures of Foreign Affiliation or Relationships to Foreign Countries - Covered Individuals

The term "covered individual" means any individual who contributes in a substantive and meaningful way to the scientific development or execution of a research and development project proposed to be carried out with a research and development award from a federal research agency. The U.S. DOT SBIR program considers the Principal Investigator and individuals identified as key personnel in a proposal, to include subcontractors or consultants, to be covered

individuals. DOT may further designate covered individuals during award negotiations or the award period of performance. See section 2.4 for additional information on these disclosures. ***If you are submitting more than one proposal, a separate disclosure form must be completed for each proposal*** as the "covered individuals" may vary between proposals.

Technical and Business Assistance (TABA)
TABA requests are now ***required at the time of proposal submission***. See section 3.5.4 if you are interested in receiving TABA.

Artificial Intelligence (AI) and Large Language Models (LLM)
To comply with Presidential Memoranda M-25-22: Driving Efficient Acquisition of Artificial Intelligence in Government and M-26-04: Increasing Public Trust in Artificial Intelligence Through Unbiased AI Principles, the U.S DOT SBIR Program has added a section to the Technical Proposal to collect information on proposed use or delivery of AI or LLM models within the SBIR proposals. See section 3.3.1.

Contents

1. PROGRAM DESCRIPTION

1.1 Introduction

The Small Business Innovation Research (SBIR) program encourages small businesses to engage in research or research and development (R/R&D) that has the potential for commercialization and meets federal R/R&D objectives. It was established by the Small Business Innovation Development Act of 1982 [Public Law (P.L.) 97-219] and is codified at 15 U.S.C. 638. The Small Business Innovation and Economic Security Act [P.L. 119-83] reauthorizes the program through September 30, 2031. The Small Business Administration (SBA) administers the program across participating agencies. More information is available at https://www.sbir.gov/.

The United States Department of Transportation (U.S. DOT) welcomes small businesses to participate in its 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 in section 9 of this solicitation. The U.S. DOT SBIR program does not accept unsolicited proposals.

1.2 Three-Phase Program

Phase I. Phase I establishes the technical merit, feasibility, and commercial potential of the proposed R/R&D efforts. The basis for award is scientific and technical merit of the proposal, its commercial potential, and its relevance to U.S. DOT requirements and current research priorities as defined in the research topics. For the U.S. DOT SBIR program, Phase I awards may be funded up to $200,000, unless otherwise noted in section 9, and have a 6-month period of performance.

Phase II. The objective of Phase II is to continue the R/R&D effort from the completed Phase I. The basis for a Phase II award is the results of Phase I, scientific and technical merit, the commercial potential, and continued relevance to U.S. DOT requirements and research priorities. For the U.S. DOT SBIR Program, contracts for Phase II proposals may be funded up to $1,500,000, unless otherwise noted, and have a period of performance of up to 24 months.

All U.S. DOT SBIR Phase I awardees who successfully complete Phase I are eligible to submit a Phase II proposal for evaluation and possible selection for award. Guidance on how and when to submit a Phase II proposal, including the commercialization plan, will be provided during the Phase I period of performance. If invited by the Government, a Phase II awardee may receive one additional Phase II award, identified by U.S. DOT as a Phase IIB, to continue the Phase II work.

Phase III. SBIR Phase III is work that derives from, extends, or logically concludes effort(s) performed under a Phase I and/or Phase II award. 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, additional R/R&D, or a combination thereof.

1.3 Eligibility

SBIR eligibility requirements are unique and do not correspond to other small business programs.

1.3.1 Size & Ownership

Regulations governing size and ownership requirements for the SBIR program are found at 13 C.F.R Part 121.701-121.705. See SBA's Guide to SBIR/STTR (Small Business Technology Transfer) Program Eligibility for additional details.

1.3.2 Restrictions on Venture Capital Owned Businesses

The U.S. DOT does not currently use the authority that allows companies that are majority-owned by multiple venture capital operating companies (VCOCs), hedge funds or private equity firms to participate in the SBIR Program. Proposals submitted by Small Business Concerns (SBCs) with this ownership model will not be considered for award. This does not include SBCs that are majority-owned by a single VCOC, hedge fund, or private equity firm that is itself an SBC.

1.3.3 Principal Investigator Employment Requirement

For both Phase I and Phase II, the primary employment of the Principal Investigator (PI) must be with the SBC at the time of award and throughout performance. Primary employment means that more than one-half of the PI's employment time is spent with the SBC. This precludes full-time employment with another organization. Occasionally, deviations from this requirement may occur, but must be approved in writing by the Contracting Officer after consultation with the SBIR program manager. An SBC may replace the PI, subject to approval in writing by the Contracting Officer.

1.3.4 Performance of Work Requirements

Phase I. A minimum of two-thirds (at least 66.7%) of the research or analytical effort must be performed by the awardee.

Phase II. A minimum of one-half (at least 50%) of the research or analytical effort must be performed by the awardee.

To calculate percentages of work, the sum of all direct and indirect costs attributable to either the SBC or the subcontractors and consultants represents the numerator, and the total cost of the proposal (i.e., total cost before profit is applied) is the denominator for each calculation. *Note: General & Administrative (G&A) costs, if proposed, will only be attributed to your SBC*.

Percentage of Work Effort for Your SBC =

$$\frac{\text{SBC's Direct Costs + SBC's Indirect Costs + SBC G\&A}}{\text{Total Proposal Cost (before profit)}}$$

Percentage of Work Effort for Subcontractors and Consultants =

$$\frac{\text{Subcontractor/Consultant's Direct Costs + Subcontractor/Consultant's Indirect Costs (no G\&A)}}{\text{Total Proposal Cost (before profit)}}$$

Definitions:

- Direct Costs: Costs directly tied to the proposed work (e.g., labor, materials, or services) and allocated to the SBC or subcontractors/consultants.
- Indirect Costs: Business expenses or overhead costs not directly tied to the proposed work, allocated to the SBC or subcontractors/consultants.
- G&A Costs: General & Administrative expenses allocated only to the SBC.
- Total Proposal Cost (before profit): The sum of all direct and indirect costs across SBC and subcontractors, excluding profit.

1.3.5 Location of Work Requirements

For both Phase I and Phase II, the R/R&D work must be performed in the United States. However, based on a rare and unique circumstance, a particular portion of the R/R&D work may be performed or obtained in a country outside of the United States. For example, if a supply, material, or other item or project requirement is not available in the United States. The Contracting Officer must approve each specific condition in writing before award.

1.3.6 Performance Benchmark Requirements for Phase I Eligibility

Performance benchmark requirements are available at https://www.sbir.gov/performance-benchmarks. You are required to update and maintain your organization's SBIR.gov Company Commercialization Report. On June 1st of each year, SBA identifies companies that fail to meet the transition benchmarks. Before submitting a proposal, you must verify your eligibility for Phase I awards on SBA's SBIR website.

Phase I to Phase II Transition Rate. SBCs that have received 21 or more Phase I awards during the past five fiscal years, excluding the most recently completed fiscal year. The U.S. DOT's Phase I to Phase II transition rate is at least 0.25 based on an SBC's total number of Phase I and II awards during the five-year period.

Commercialization Rate Benchmark. SBCs that have received 16 or more Phase II awards during the past 10 fiscal years, excluding the two most recently completed fiscal years. Those SBCs must average at least $100,000.00 in sales and/or investments per Phase II award received during the period or have received patents for at least 15% of the Phase II awards received during the period.

Increased performance standards for more experienced SBCs.
Phase I to Phase II Transition. SBCs that have received 51 or more Phase I awards during the past five fiscal years, excluding the most recently completed fiscal year. They must average a ratio of Phase II to Phase I awards of at least 0.50 during the measurement period.

Commercialization Rate - Tier 1. SBCs that have 51 or more Phase II awards during the past 10 fiscal years, excluding the two most recently completed fiscal years. They must average at least $250,000 in aggregate sales and investments per Phase II award received during the period.

Commercialization Rate - Tier 2. SBCs that have 101 or more Phase II awards during the past 10 fiscal years, excluding the two most recently completed fiscal years. They must average at least $450,000 in aggregate sales and investments per Phase II award received during the period.

Note: Patents cannot be used to pass the increased performance standards.

1.4 Contact Information

To ensure fairness and facilitate tracking, all communication regarding this solicitation must be directed through the program's email:

U.S. DOT SBIR Program Inbox
dotsbir@dot.gov

1.5 Solicitation Questions

Be sure to review the U.S. DOT SBIR program Frequently Asked Questions (FAQs). Administrative questions not answered in the FAQs, or questions regarding Appendix C: Contract Pricing Worksheet, must be submitted to the program email (dotsbir@dot.gov) **no later than 3:00 p.m. ET on Tuesday, June 30, 2026**. Questions received after this time may not be answered.

The following inquiries will **not** be addressed during the open solicitation period:

- Inquiries regarding proposal status.
- Technical questions on research topics. To review the pre-solicitation technical questions and answers, visit https://usdot.uservoice.com/forums/967226-u-s-dot-fy-2026-phase-i-pre-solicitation-q-a.

To support full and open competition and comply with the Procurement Integrity Act, 41 U.S.C sections 2101-2107 requirements, during the solicitation open period (from solicitation issuance until release of award recommendation list), any contact with U.S. DOT relative to this solicitation is restricted to the officials identified in this Solicitation. Contact with U.S. DOT officials (excluding certain offices and positions such as the DOT Office of the Inspector General and the U.S. DOT/Office of the Secretary) from or at any U.S. DOT agency, other than those officials identified in this solicitation, may result in rejection of the proposal attributable to such unauthorized contact.

1.6 Reporting Fraud, Waste, and Abuse

The U.S. DOT SBIR program takes fraud, waste, and abuse seriously. Anyone who observes fraud, waste, abuse, or mismanagement or receives an allegation of fraud, waste, abuse, or mismanagement from a federal employee, contractor, grantee, or any other source with regards to the U.S. DOT, its SBIR program, an SBIR solicitation, or an SBIR award is responsible for reporting it to the U.S. DOT Office of Inspector General Hotline (Phone: 800-424-9071, Email: hotline@oig.dot.gov).

Find more information, including the most recent training provided to U.S. DOT SBIR participants, at https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/report-fraud-waste-and-abuse.

1.7 Definitions

Funding Agreement: Any contract, grant, or cooperative agreement between any federal agency and any SBC 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 only awards contracts 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.

Small Business Concern (SBC): For SBIR solicitations, an SBC is a concern that meets the SBIR program eligibility requirements set forth in 13 C.F.R § 121.702, "What size and eligibility standards are applicable to the SBIR and STTR programs?".

SBIR Data: All data developed or generated in the performance of an SBIR award, including Technical Data and Computer Software. 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 are 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 Data for Government purposes, and is relieved of all disclosure prohibitions and assumes no liability for unauthorized use of these Data by third parties. The Government receives unlimited rights in all Form, Fit, and Function Data, Operations, Maintenance, Installation, or Training Purposes (OMIT) Data, and unmarked SBIR Data.

Additional definitions can be found within our FAQs: https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/faqs

1.8 Manufacturing and Energy Information

Executive Order (EO) 13329, Encouraging Innovation in Manufacturing, February 26, 2004, requires SBIR agencies, to the extent permitted by law and consistent with the mission of that agency, to give high priority within the SBIR programs to manufacturing-related R&D. This includes technologies related to manufacturing processes, equipment and systems, or manufacturing workforce skills and protection.

The Energy Independence and Security Act of 2007, December 19, 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 SBIR agencies give priority to SBCs that participate in or conduct energy efficiency or alternative energy system research and development projects.

1.9 Small Business Administration (SBA) Applicant Resources

If you need assistance, the SBA works with several local partners of various organizational types to train and support potential SBIR/STTR applicants around the country on topics from proposal assistance to SAM registration, and commercialization support to industry connections. To find out more information on the specific types of SBA federal resources available, visit: https://www.sbir.gov/community.

2. CERTIFICATIONS & REGISTRATIONS

2.1 System for Award Management (SAM)

To submit a proposal to this solicitation, you must have an active SAM registration **at the time of proposal submission/solicitation close date, at time of award, and throughout an award period of performance**. Obtaining a new SAM registration or updating a lapsed registration may take 10 or more business days so it is imperative that you start this process significantly before the solicitation's closing date. Additional information on SAM and the registration process is provided on the SAM website at: https://sam.gov/content/home. A UEI number is provided through the SAM registration.

To verify that your SAM registration is current, you must provide a PDF copy of the registration page(s) with your proposal package (see section 3.3.2) which includes the date retrieved from SAM. You must update your SBC's representations and certifications as necessary, and at least annually, to keep them current, accurate, and complete to be eligible for award.

2.2 SBA's SBIR Company Registry

You must complete your SBIR.gov Company Registration prior to submitting your proposal at https://app.www.sbir.gov/company-registration/overview. This will assign your firm an SBC Control ID and Proof of Registration Certificate. During the registration process you will be directed to OKTA to complete the login and Two Factor Authentication (TFA) process. NOTE: Each company registration must use a unique email address not previously registered.

Ensure that all fields in the registration form are completed accurately. The SAM.gov UEI number and Point of Contact email must exactly match the details in your SAM.gov account, as SBIR.gov uses SAM.gov data to verify company information.

If you need assistance with your OKTA user account, please contact OKTA Support. Their contact information is provided below for your convenience.

OKTA Support
Need Help: 866-SBA-HELP
Monday through Friday from 8 a.m. to 8 p.m. ET.

To verify you are registered in the SBIR Company Registry, you must provide a PDF copy of the Registration Certificate with your proposal package (see section 3.3.2).

2.3 Certifications

You must answer the certification questions in the automated proposal submission system. Carefully read each of the statements. U.S. DOT SBIR relies on the information provided to determine eligibility for an SBIR award. The definitions for the terms used in the certifications are set forth in the Small Business Act, SBA regulations (13 C.F.R Part 121), the SBIR/STTR Policy

Directive, and any statutory and regulatory provisions referenced in those authorities.

Similar certifications are used to ensure continued compliance with program requirements throughout the lifecycle of your award.

- For Phase I awards: The U.S. DOT SBIR program collects funding certifications with invoice submission as a condition for payment. A lifecycle certification must be completed along with the final funding certification when submitting the final invoice.
- For Phase II awards: In addition to the certifications noted for Phase I, a lifecycle certification is collected prior to receiving more than 50% of the total award amount. You are also required to submit an updated Disclosures of Foreign Affiliation or Relationships to Foreign Countries form (see next section) prior to receiving more than 50% of the total award amount.

If the Contracting Officer believes that you may not meet certain eligibility requirements for award, they may request you provide clarification or additional supporting documentation. If the Contracting Officer still believes you are not eligible, you must file a size protest with the SBA, who will determine eligibility.

2.4 Disclosures of Foreign Affiliation or Relationships to Foreign Countries

Each SBC submitting a proposal for an SBIR award must disclose information regarding ties to the People's Republic of China and other foreign countries. If submitting, you must complete a disclosure form at the U.S. DOT's online page at: https://forms.office.com/g/BmmrYKqhpz on or before the solicitation closing date.

If you are submitting more than one proposal, **a separate disclosure form must be completed for each proposal** as the "covered individuals" may vary between proposals. The term "covered individual" means any individual who contributes in a substantive and meaningful way to the scientific development or execution of a research and development project proposed to be carried out with a research and development award from a federal research agency. The U.S. DOT SBIR program considers the Principal Investigator and individuals identified as key personnel in a proposal, to include subcontractors or consultants, to be covered individuals. DOT may further designate covered individuals during award negotiations or the award period of performance.

Please note that foreign involvement or investment does not independently disqualify you from receiving an SBIR award but failing to disclose such affiliations or relationships may result in denial of an award. Additional details on the disclosure requirements can be found in the SBIR and STTR Extension Act of 2022, Small Business Innovation and Economic Security Act, or at https://www.sbir.gov/foreign_disclosures.

3. PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

3.1 Overview

This solicitation is for Phase I R/R&D proposals on advanced, innovative concepts with relevance to some aspect of the national transportation system or the ability of an Operating Administration of the U.S. DOT to perform its mission. Proposals should be confined to scientific or engineering research, which may be carried out through construction and evaluation.

Phase I R/R&D proposals should demonstrate a sound approach to the investigation of a high priority transportation related scientific or engineering problem under one of the research topics listed in section 9 of this solicitation. Your proposal may respond to any of the research topics but must be limited to one topic. The same, or an essentially equivalent proposal cannot be submitted to more than one topic. However, you may submit multiple unique proposals to different topics or to the same topic under this solicitation. If similar research is discussed in more than one topic, you should choose the topic which appears to be most relevant to your technical concept.

3.2 Solicitation Requirements

Your proposal must be checked carefully to ensure you have complied with all preparation instructions. There is a Proposal Submission Checklist in section 8 as well. The following requirements must be met by the solicitation closing date/time for the proposal to be evaluated for award.

3.2.1 Formatting Requirements

Proposal packages must be complete, accurate and submitted as four separate files through the automated proposal submission system.

Technical Section

The technical section must be submitted as a single PDF according to the following requirements:

- The technical proposal **must not exceed 15 pages**.
    - Technical proposals more than 15 pages will not be considered for review or award.
    - The Table of Contents and Prior Phase II Awards do not count toward the 15-page limit.
    - Letters of support, if included, will count toward the 15-page limit.
    - Do not include hyperlinks to external websites that provide supplemental content to the information contained in the proposal, or additional attachments or appendices that go beyond the 15-page limit as they will NOT be considered in evaluation.
- Proposals must be on standard letter size pages (8.5" by 11").
- Font size must be no smaller than 10-point.
- Margins must be 1” on all sides.
- All pages should be numbered consecutively.

Appendices A and B and Registrations
Appendix A: Signature Page and Appendix B: Project Summary must use the templates provided by the U.S. DOT SBIR program. Examples and links can be found in section 8. Proof of your SBA SBIR Company Registry confirmation and SAM Registration must be included with Appendices A and B. These four (4) items must be submitted as a single separate PDF file which does not count toward the 15-page limit for the Technical Section.

Appendix C: Contract Pricing Worksheet
The Contract Pricing Worksheet must be submitted as an Excel file using the template provided by the U.S. DOT SBIR program to be considered responsive. The link can be found in section 8. This section does not count toward the 15-page limit for the technical section.

Contract Pricing Worksheet Supporting Documentation
Supporting documentation for Appendix C: Contract Pricing Worksheet must be submitted as a single PDF file and include information to justify all proposed costs/prices. This section does not count toward the 15-page limit for the Technical Section and there is no limit on the number of pages for the Contract Pricing Worksheet supporting documentation.

3.2.2 File Naming Conventions

You must use the following naming conventions for each of the four separate files you submit:

- The first three characters must be the topic number the proposal is associated with (e.g., FH2).
- The remaining characters must include an abbreviation of the SBC's name and a distinct character to designate each file (e.g., 1, 2, 3, and 4).

Multiple Proposal Submissions & Naming Conventions
If you choose to submit unique proposals to different topics, or multiple separate proposals to the same topic under this solicitation, follow the naming conventions below.

- **To submit more than one proposal in the proposal website**, add the topic number at the end of the company name in the 'Team Name' field (e.g., SBC, Inc. – FH1). This will create a new team profile for each proposal.
- **If submitting multiple proposals under the same topic**, please add "a", "b", etc. respectively after the topic number to each Team Name. (e.g., SBC, Inc. – FH2a).

3.2.3 Proprietary Information in the Proposal

Information contained in unsuccessful proposals will remain the property of the SBC. The Government will, however, retain copies of all proposals. Public release of information from any proposal submitted will be subject to existing statutory and regulatory requirements.

The U.S. DOT prefers that SBCs avoid the inclusion of proprietary data in proposals. If necessary,

limit proprietary information to only what is essential to your proposal. If proprietary information is provided in a proposal that constitutes a trade secret, commercial, or financial information, it will be treated in confidence, to the extent permitted by law, provided the proposal is clearly marked as follows:

This legend must appear on the title page of your proposal:
"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 is 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,

This legend must appear on each page that contains information you wish to protect:
"Use or disclosure of information contained on this sheet is subject to the restriction on the title page of this proposal."

3.3 Specific Instructions for the Four Separate Proposal Files

3.3.1 Technical Section (PDF)

A **single PDF** that includes the Technical Proposal (not to exceed 15 pages) and Prior Phase II Awards list (which does not count toward the 15-page limit.

Technical Proposal – Not to exceed 15 pages
You are encouraged to have a Table of Contents (which does not count toward the 15-page limit) to ensure you include the required sections in the following order. Your proposal must include all the following headings in bold. In cases where a section does not apply, you must include the heading and state "Not Applicable".

1. **Identification and Significance of the Problem or Opportunity.** State the specific technical problem or innovative research opportunity addressed and its potential benefit to the national transportation system.
2. **Phase I Technical Objectives.** State the specific objectives of your Phase I R/R&D effort; including the technical question(s) the research seeks to answer to determine the feasibility of the proposed approach.
3. **Phase I Work Plan.** Describe your Phase I R/R&D plan, indicating what will be done, where it will be done, when it will be done, and how the R/R&D will be managed or directed and carried out. Address the objectives and the question(s) cited in the technical objectives. Discuss in detail the methods planned to achieve each objective or task, including the level of effort associated with each task.

4. **Related Research or R&D.** Describe significant R/R&D that is directly related to your proposal including any R/R&D conducted by the principal investigator or your SBC. Describe how it relates to your proposed effort, and any planned coordination with outside sources. You must persuade reviewers of your awareness of recent, key R/R&D conducted by others in the specific topic area.
5. **Key Personnel and Bibliography of Directly Related Work.** Identify all key personnel involved in Phase I including title, role or labor category, related education, experience, and bibliographic information. Where histories are extensive, summaries that focus on the most relevant experience/publications are desired and may be necessary to meet page limits.
6. **Relationship with Future Research and Development.** State the anticipated results if the project is successful (Phase I and Phase II). Discuss the significance of the Phase I effort in providing a foundation for a Phase II R/R&D effort.
7. **Facilities.** Provide a detailed description of the availability and location of instrumentation and physical facilities proposed for Phase I.
8. **Subcontractors/Consultants.** Involvement of subcontractors or consultants in the planning and research stages of the project is permitted within the work limits described in section 1.3.4. Describe any intended subcontractor or consultant involvement in detail.
9. **Potential Post Applications.** Briefly describe whether and how the proposed project appears to have (1) potential commercial application; and (2) potential use by the Federal Government.
10. **Similar Proposals and/or Awards.** While you are allowed, with proper notification, to submit identical proposals, or proposals containing a significant amount of essentially equivalent work, for consideration under numerous federal program solicitations, **it is unlawful to enter into funding agreements requiring essentially equivalent effort**. If there is any question concerning this, you must disclose it to the soliciting agency or agencies before award. If you elect to submit similar or identical proposals containing equivalent work under other federal program solicitations, a statement must be included in each proposal indicating:
    a. The name and address of the agencies to which proposals were submitted or from which awards were received.
    b. Date of proposal submission or date of award.
    c. Title, number, and date of SBIR program solicitations under which proposals were submitted or awards received.
    d. The applicable research topics for each SBIR proposal submitted or award received.
    e. Titles of research projects.
    f. Name and title of principal investigator for each proposal submitted or award received.

11. **Human Factors (only if applicable)**. 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 §11.104, 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 U.S. DOT advises against submitting proposals that require the use of Human Subjects testing during Phase I.** For more information, visit the FAQ at https://www.volpe.dot.gov/work-with-us/small-business-innovation-research/faqs.

12. **Artificial Intelligence (AI) and Large Language Models (LLM) (only if applicable)**. Identify whether:
    - The output of the effort proposed is an AI and/or LLM product or service.
    - The conduct of the work includes AI and/or LLM products or services.
        - The use of AI and/or LLM products or services will be integrated into the technology being developed.
        - The use of AI and/or LLM products or services is incidental to the technology being developed.
    - Neither the output of the effort nor the conduct of the work includes the use of AI and/or LLM products or services.

Prior SBIR Phase II Awards
If your SBC has received more than 15 Phase II SBIR/STTR awards in the prior five fiscal years, you must submit the following information for each Phase II which does not count toward the 15-page limit of the Technical Proposal:

- Name of the awarding agency
- Date of award
- Funding agreement number
- Principal investigator name
- Dollar value of award
- Topic or subtopic title
- Any follow-on agreement dollar amount
- Source and date of follow-on commitment
- Current commercialization status

3.3.2 Appendices A and B with Registrations (PDF)

The following four documents must be combined into a single PDF file.

Appendix A: Cover Page with Signatures – First page of PDF

Complete the Appendix A template. The "topic title" block must list the topic name as shown in this solicitation. The "proposal title" block should be the name given to your proposed solution and should not be the same as the topic title. Sign and date in blocks where indicated; the date used

should be the date the proposal is submitted.

Appendix B: Project Summary – Second page of PDF
Complete the Appendix B template. The Project Summary must include at a minimum:

1. A technical abstract with a brief statement of the problem or opportunity, project objectives, and description of the effort. The abstract must be prepared in accordance with the instructions on the template.
2. Anticipated results and potential applications of the proposed research.

Note: the Project Summary of successful proposals may be published by U.S. DOT and SBA. Therefore, it must not contain classified or proprietary information.

SAM Registration Confirmation – Third Page of PDF
You must be registered in SAM at the time of proposal submission (see section 2.1). A page from SAM validating the active registration which includes the date retrieved from SAM must be included with Appendices A and B.

SBA's SBIR Company Registry Confirmation – Fourth Page of PDF
You must be registered in SBA's SBIR company registry database (see section 2.2). The PDF registration confirmation must be included with Appendices A and B.

3.3.3 Appendix C: Contract Pricing Worksheet (Excel)

The Contract Pricing Worksheet must be submitted using the Appendix C template provided by DOT. If cost breakdown items of Appendix C do not apply to the proposed project, there is no need to provide information on those tabs. When completing your cost proposal:

- Provide enough information to allow the U.S. DOT to understand how you plan to use the requested funds if an award is made.
- You may include a reasonable profit. The profit is typically evaluated using weighted guidelines and does not normally exceed 10% for SBIR contracts.
- Travel is allowable but must be justified. Examples of justified travel include travel to a test site or meetings with subcontractors or stakeholders. Travel for kickoff meetings or conferences will not be allowed for Phase I.
- You must note your SBC's EIN and UEI numbers in the Appendix C coversheet.
- Proposed TABA costs must be included in tab J.
- Proposals that exceed the Phase I award amount in section 9, not inclusive of TABA, will not be considered.
- Pricing within Appendix C must remain valid for 180 days after solicitation close date.

If you have any trouble accessing the Appendix C spreadsheet, please contact the U.S. DOT SBIR Program via email at dotsbir@dot.gov no later than June 30, 2026.

3.3.4 Contract Pricing Worksheet Supporting Documentation (PDF)

You must include supporting documentation for all costs proposed (e.g., material quotes, subcontractor proposals, indirect rate calculations, TABA quotes, etc.). See the first two tabs of Appendix C for instructions and further examples of supporting documentation. ***These must be submitted as a single separate file in PDF format.***

3.4 Proposal Submission Deadline

Complete proposal packages must be received no later than **3:00 p.m. ET on Tuesday, July 7, 2026,** through U.S. DOT's automated proposal submission system at https://usg.valideval.com/teams/usdot_2026/signup. **Proposals received after this time will automatically be rejected; no exceptions will be permitted**.

Please be aware that the submittal process requires answering numerous questions as well as multiple document uploads. **Be sure to allow ample time to complete the multi-step submittal process.** Proposals are not considered received by the Government until this multi-step process is complete. You are encouraged to submit your proposal(s) as early as possible.

3.5 Other Information

3.5.1 Proposal Handling

Proposals will be made available to government employees, including subject matter experts responsible for evaluating the proposals and Volpe Center staff responsible for the SBIR program.

In the conduct of proposal processing, U.S. DOT may need to provide access to the proposal package to U.S. DOT contractor personnel responsible for DOT's automated proposal submission system, Valid Eval. Access to such data requires the contractors to fully protect the information from unauthorized use or disclosure, in accordance with 41 U.S.C. §2101-2107.

3.5.2 Release of Certain Proposal Information

In submitting a proposal, you agree to permit the Government to disclose publicly the information contained in the Cover form and Proposal Summary form, which includes the technical abstract. Other proposal data is your property, and U.S. DOT will protect it from public disclosure to the extent permitted by law, including requests submitted under the Freedom of Information Act (FOIA).

3.5.3 Fraudulent Information

Submitting plagiarized information and/or false information may result in:

- A proposal being deemed non-responsive,
- A recommendation for Phase I award being rescinded,
- Termination of an award, and/or
- Referral to the Suspension and Debarment authority for review and action.

3.5.4 Technical and Business Assistance (TABA)

The TABA program offers funding in addition to your SBIR award to support your commercialization efforts allowing you to stay focused on research and development. The purpose of TABA is to assist you 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; (4) commercializing the SBIR products or processes; and (5) screening for potential foreign involvement in technology development or commercialization activities. Examples of activities include:

- Market research and/or validation,
- Development of regulatory and/or manufacturing plans,
- Assistance with product sales,
- Assistance with intellectual property (IP) protections,
- Cybersecurity assistance, and
- Access to technical and business literature that is available through online databases.

Note: The Government cannot fund specific aspects of some TABA services. If your proposal is recommended and includes unallowable costs , you may be required to revise or resubmit your TABA request. Examples of TABA funding that cannot be supported are audit services, contributions to the SBIR fee, bookkeeping services, payroll management, and patent filing costs.

The U.S. DOT SBIR program provides TABA funding up to $6,500 for Phase I awards. TABA funding for Phase II awards is currently $13,000 and may be increased at the discretion of the U.S. DOT SBIR Program. These amounts are in addition to the award amount and ***are not subject to the application of indirect rates or profit***. To utilize TABA services, you must obtain a qualified vendor or provide justification for internal staff. TABA vendors must have the experience and qualifications to support the TABA services proposed. If internal efforts are proposed, the staff or other price elements must be documented within the TABA portion of the pricing worksheet.

Requesting TABA

To request TABA, you must provide a quote from your vendor of the specific services and deliverables to be provided or outline of staff activities to be conducted. The qualifications and experience of your proposed vendor or staff, and pricing information are to be included within your proposal submission. The requested funding amount, not to exceed $6,500 in Phase I, must be included in tab J of Appendix C. The supporting TABA quote or other documentation must be included with the Appendix D documents. Information required for your TABA quote includes:

- Contact information of the vendor/staff (name, address, phone number, email address, and website).
- Description of the vendor or staff's expertise and knowledge of providing the desired technical and business assistance services.
- Itemized list of services and associated costs for each service the TABA vendor/staff will provide; this includes the number of hours and hourly cost for each service, when appropriate.

- Description of the deliverable(s) the TABA vendor/staff will provide for each service summarizing the outcome of the TABA services.

Given the limited funding and short timeframe of Phase I awards, the U.S. DOT SBIR program recommends using Phase I TABA funding to 1) support development of your Phase II Commercialization Plan, and 2) determining services that may be needed if you receive a Phase II award.

If you are unsure of where to start, you can turn to your local Federal and State Technology (FAST) Partnership Program awardee or Small Business Development Center for assistance.

3.5.5 Manufacturing Extension Partnership (MEP)

MEP is a nationwide network of locally managed extension centers with over 1,400 technical experts, located in every state. You may contact your local National Institute of Standards and Technology (NIST) MEP for manufacturing and other business-related support services. The MEP works with small and mid-sized companies to help 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. 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.

3.6 Phase II Proposal Submission

A separate solicitation will not be issued requesting Phase II proposals, and unsolicited proposals will not be accepted. All proposing SBCs that receive a Phase I award from this solicitation are eligible to submit Phase II proposals. Approximately 30 days prior to the end of the Phase I efforts, the U.S. DOT SBIR program will provide Phase I awardees with 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.

4. METHOD OF SELECTION AND EVALUATION CRITERIA

4.1 Basis of Award

All Phase I proposals will be evaluated and judged on a competitive basis. Proposals will be initially screened to determine responsiveness to the solicitation requirements. Proposals passing the initial screening will be technically evaluated by engineers or scientists to determine the most promising technical and scientific approaches. Each proposal will be judged on its own merit.

The U.S. DOT is under no obligation to fund any proposal or any specific number of proposals in a topic. The U.S. DOT reserves the right to award more or less than the anticipated quantity of awards in section 5.1, and to make no awards under a given topic.

4.2 Proposal Responsiveness Review

Each proposal will be examined to determine if it is complete and has met all the solicitation requirements. A proposal that does not meet the requirements of the solicitation as described in section 3 may be excluded from further consideration.

4.3 Evaluation and Selection of Awardees

The process for evaluating responsive proposals will be conducted to minimize the time from submission to selection and award. Federal employees with subject matter expertise will evaluate each eligible proposal according to the evaluation criteria below. After evaluations are complete, the most favorably rated proposal(s) within each topic will be considered for award. Phase I award recommendations will be made to the responsive and responsible SBCs whose proposal provides the best value to the government, based on the technical and scientific merit of the proposal.

4.4 Phase I Evaluation Criteria

Details of what is considered within each criterion are included below.

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

4.5 Due Diligence Process

The U.S. DOT SBIR program will review proposals submitted in response to this solicitation to assess security risks. The U.S. DOT SBIR program will use information provided in response to the Disclosures of Foreign Affiliations or Relationships to Foreign Countries form and the proposal to conduct a risk-based due diligence review on:

- Cybersecurity practices;
- Patent analysis;
- Employee analysis;
- Foreign ownership of the SBC, including the financial ties and obligations (which includes surety, equity, and debt obligations) of the SBC, its employees, and covered individuals to a foreign country, foreign person, or foreign entity;
- Foreign affiliations of a covered individual, owner, or other key personnel of a small business concern with an entity in a foreign country of concern;
- Investment relationships of a small business concern with an individual or entity in a foreign country of concern;
- Technology licensing agreements or joint ventures (including joint venture-like agreements) with an individual or entity in a foreign country of concern; and
- Business relationships between a covered individual, owner, or other key personnel of a small business concern and an individual or entity in a foreign country of concern.

The U.S. DOT may not make awards that pose an unacceptable risk to national security. If the risk-based due diligence review concludes that an SBC should not be eligible for the specific SBIR award due to a security risk, the proposal will not receive consideration for possible award regardless of the results of the technical review of the proposal.

4.6 Time to Award Requirements

The U.S. DOT SBIR program 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, we will notify each applicant as soon as practicable.

The U.S. DOT SBIR program intends to make Phase I awards within 180 days after the close of the solicitation as required by the SBIR Policy Directive.

4.7 Feedback Requests

After you are notified of your award recommendation status, feedback will be available electronically via the automated proposal submission system website. You may access the feedback within ten (10) calendar days from your notification. If you do not access the feedback within the ten (10) calendar days, the system will close without further notice.

The information provided will consist of a summary of ratings across all evaluation criteria and may

also include a summary set of comments from the government evaluators. The identity of the evaluators will not be disclosed.

Due to the competitive nature of the program and limited funding, recommendations to fund or not fund a proposal are final. U.S. DOT SBIR will not reconsider selection decisions or provide additional information regarding the final decision. You are encouraged to use the feedback provided to understand the outcome and develop plans to strengthen future proposals.

5. CONSIDERATIONS

5.1 Funding Awards

U.S. DOT anticipates awarding twelve (12) 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 awards is subject to the availability of funding and the responses received to the research topics described in section 9.

5.1.1 Dollar Value and Type of Awards

Phase I Awards may be funded up to $200,000, unless otherwise noted in section 9, with a six-month period of performance. The U.S. DOT intends to award Firm-Fixed-Price (FFP) purchase orders utilizing FAR Part 13 Simplified Procedures for Noncommercial Acquisitions (as deviated by DOT FAR Class Deviation 2026-08).

Phase II Awards may be funded up to $1,500,000 (unless otherwise noted in section 9) and can have a period of performance of up to 24 months from the date of contract award. The U.S. DOT intends to award Firm-Fixed-Price (FFP) contracts for Phase II efforts utilizing FAR Part 15 Contracting by Negotiation procedures (as deviated by DOT FAR Class Deviation 2026-15), though other contract types may be considered, if appropriate.

The Contracting Officer will determine if a contract type other than FFP is appropriate for a 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.

The U.S. DOT will require written acceptance of the purchase order (Phase I) or contract (Phase II) by the SBC at the time of award. The purchase order or contract will incorporate the SBC's technical proposal as either a statement of work (SOW) or performance work statement (PWS). Award of a bilaterally signed purchase order or contract is subject to the availability of funding.

The DOT FAR Class Deviations can be found at https://www.acquisition.gov/far-overhaul/far-part-deviation-guide.

5.2 Profit

A reasonable profit is allowed on awards to SBCs under the U.S. DOT SBIR program consistent with the Federal Acquisition Regulations. For SBIR, profit does not typically exceed 10%.

5.3 Cost Sharing

Cost sharing is not applicable to Phase I awards. For Phase II, the U.S. DOT permits cost sharing, if appropriate, however, cost sharing is not required, is not a factor in evaluation, and will not be used in the determination of the percentage of work performed by the SBC on the contract.

5.4 Reports

For Phase I SBIR awards, awardees will be required to submit three (3) reports, consisting of two (2) interim narrative reports and a comprehensive final report. These reports will be due at two-month intervals starting at the end of month two. An acceptable report is one that describes all efforts and progress made on the R/R&D from the start of the contract through the report submittal time.

5.5 Payment Schedule

Awardees may invoice for three equal partial payments for Phase I awards. Invoices must be submitted in accordance with the instructions in the award document and in conjunction with, or after the submission of the reports described above. Invoices submitted before submission of the applicable report will be rejected until you submit an acceptable report. Payment will be based on the Government's acceptance of the applicable report.

For Phase II, quarterly payments are expected to be made in alignment with required deliverables. The timing and amount of payments may be structured based on work proposed or other factors.

To receive reimbursement for TABA services, a report or other acceptable deliverable must be submitted showing the services received and the related costs for those services.

5.6 Innovations, Inventions, and Patents

Protection Period for Rights in Data Developed under SBIR Funding Agreements

Rights in technical data, including software developed under any award resulting from this solicitation, will remain with the SBC except that the Government will have the limited right to use such data for Government purposes and will not release such data outside the Government without permission of the SBC for not less than twenty (20) years from the award date of the SBIR project from which the data was generated. 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 data for government purposes, and is relieved of all disclosure prohibitions and assumes no liability for unauthorized use of these data by third parties. The Government receives Unlimited Rights in Form, Fit, and Function Data, OMIT Data, and all unmarked SBIR Data. See the SBIR/STTR Policy Directive for additional information.

Copyrights

With prior written permission of the Contracting Officer, you 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 Government and requires that each publication contain an appropriate acknowledgement and disclaimer statement.

Patents/Invention Reporting

You must 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.

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 to others in certain circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must manufacture it domestically.

5.7 Joint Ventures or Limited Partnerships

Joint ventures (JV) and limited partnerships (LP) are permitted to submit proposal(s) to this solicitation provided the entity created qualifies as an SBC in accordance with the Small Business Act, 15 U.S.C. 632, and the definition of SBC included in this solicitation (Paragraph I.E). JVs must be properly registered in SAM as a JV. As this can be a time-consuming process, if proposing as a JV is anticipated, working with SAM immediately to get the registration done is highly recommended.

5.8 Novated/Successor in Interest/Revised Funding Agreements

An SBIR awardee may include, and SBIR work may be performed by, those identified via a "novated" or "successor in interest" or similarly revised funding agreement.

5.9 Awardee Commitments

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

- **Revolutionary FAR Overhaul**: https://www.acquisition.gov/far-overhaul/far-part-deviation-guide
- **TAR**: https://www.acquisition.gov/tar

The summary statements that follow are illustrative of the types of clauses to which you would be committed. This list does not represent a complete list of clauses or the specific wording of the clauses to be included in SBIR awards. A complete copy of the terms and conditions will be provided upon issuance of the contract for signature prior to award.

1. **Standards of Work.** Work performed under the Funding Agreement must conform to high professional standards.
2. **Inspection.** Work performed under the Funding Agreement is subject to Government inspection and evaluation at all times.
3. **Examination of Records.** The Comptroller General (or a duly authorized representative) must have the right to examine any pertinent records of the Awardee involving transactions related to this Funding Agreement.

4. **Default.** The Federal Government may terminate the Funding Agreement if the contractor fails to perform the work contracted.
5. **Termination for Convenience.** The Funding Agreement may be terminated at any time by the Federal Government if it deems termination to be in its best interest, in which case the Awardee will be compensated for work performed and for reasonable termination costs.
6. **Disputes.** Any dispute concerning the Funding Agreement that cannot be resolved by agreement must be decided by the contracting officer with right of appeal.
7. **Contract Work Hours.** The Awardee may not require an employee to work more than 8 hours a day or 40 hours a week unless the employee is compensated accordingly (for example, overtime pay).
8. **Equal Opportunity.** The Awardee will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
9. **Equal Opportunity for Veterans.** The Awardee will not discriminate against any employee or application for employment because he or she is a disabled veteran or veteran of the Vietnam era.
10. **Equal Opportunity for People with Disabilities.** The Awardee will not discriminate against any employee or applicant for employment because he or she is physically or intellectually disabled.
11. **Officials Not To Benefit.** No Federal Government official may benefit personally from the SBIR/STTR Funding Agreement.
12. **Covenant Against Contingent Fees.** No person or agency has been employed to solicit or secure the Funding Agreement upon an understanding of compensation except bona fide employees or commercial agencies maintained by the Awardee for the purpose of securing business.
13. **Gratuities.** The Funding Agreement may be terminated by the Federal Government if any gratuities have been offered to any representative of the Government to secure the award.
14. **Patent Infringement.** The Awardee must report each notice or claim of patent infringement based on the performance of the Funding Agreement.
15. **American Made Equipment and Products**. When purchasing equipment or a product under the SBIR/STTR Funding Agreement, purchase only American-made items whenever possible.

5.10 Agency Recovery Authority and Ongoing Reporting

The U.S. DOT will:

1. Require an awardee to repay amounts received from the federal agency under an award if,
    a. The SBC makes a material misstatement that the federal agency determines poses a risk to national security; or
    b. There is a change in the SBC's ownership, entity structure, or other substantial changes in circumstances that the federal agency determines poses a risk to

national security; and

2. Require an awardee to report within thirty (30) days on:
    a. Any change to a disclosure required under the Disclosures of Foreign Affiliations or Relationships to Foreign Countries form;
    b. Any material misstatement made under paragraph (a) above; and
    c. Any change described in paragraph (b) above.

5.11 Other Considerations

Section 508 Access Board Standards

All information and communication technology (ICT) deliverables must comply with the Revised Section 508 Standards of the Rehabilitation Act and the Access Board Standards, available 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 incidental to this contract will not be required to conform to the Revised 508 Standards. Unless otherwise indicated, you represent by signature on a contract or order that all deliverables will comply with the standards.

Export Control

The export of any goods or technical data from the United States, and the disclosure of technical data to foreign nationals, may require some form of export license from the U.S. Government. You are responsible for ensuring compliance with the International Traffic in Arms Regulations (ITAR) administered by the U.S. Department of State (22 C.F.R. Parts 120 to 130), Export Administration Regulations (EAR) administered by the U.S. Department of Commerce (15 C.F.R. Parts 730 to 774), and Foreign Assets Control Regulations administered by the U.S. Department of Treasury (31 C.F.R. Parts 501 to 598), as warranted, and with compliance with all recordkeeping requirements under U.S. export regulations. Any employee who is not a U.S. citizen or a permanent resident may be restricted from working on this contract if the technology is restricted under export control laws, ITAR, or EAR unless the prior approval is obtained via a technical assistance agreement or an export license. Failure to obtain necessary export licenses may result in criminal liability under U.S. laws.

Government Property

Materials, equipment, special tooling, and special test equipment either furnished by the Government or, in a cost-type contract, acquired or fabricated by the contractor, are subject to FAR clause 52.245-1 Government Property and may also be subject to special clauses specific to certain items of property.

5.12 Additional Information

1. This solicitation reflects current planning. Although not expected, there may be inconsistencies between the information contained in the FY 2026 solicitation and the

terms and conditions of any resulting SBIR contract. The terms and conditions of the contract once executed are controlling.

2. The Government may request that you submit additional organizational, management, personnel, and financial information for the Government to consider and determine responsibility.
3. The Government is not responsible for any monies expended by you before award of any contract.
4. This solicitation is not an offer by the Government and does not obligate the Government to make any specific number of awards. Awards under this program are contingent upon the availability of funds.
5. Unsolicited proposals are not accepted under the U.S. DOT SBIR program for either Phase I or Phase II efforts. For information on unsolicited proposals, 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.
6. If an award is made pursuant to a proposal submitted under this SBIR Solicitation, you will be required to certify that you have not previously been, nor are currently being, paid for essentially equivalent work by any federal agency.

6. SUBMISSION OF PROPOSALS

Proposal packages must be received no later than **3:00 PM ET on Tuesday, July 7, 2026,** through the U.S. DOT's automated proposal submission system at https://usg.valideval.com/teams/usdot_2026/signup.

Proposals received after that time will be automatically rejected; no exceptions will be permitted. Proposals received via email or any other means will not be accepted. Do not send duplicate proposals via email or by any other means.

The submission system is open throughout the solicitation open period. Please be aware that the submittal process requires answering several questions within the proposal system in addition to uploading the required documents. **Please ensure you allow ample time to complete the multi-step submittal process. Proposals will not be considered received by the Government until this multi-step process is complete**. You are encouraged to submit your proposal(s) as early as possible.

Procurement Integrity. Submission of a proposal under this solicitation subjects you 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 FAR 3.104 (as deviated by DOT FAR Class Deviation 2026-04), prohibits the following conduct during an agency procurement: prohibits federal employees and certain Government contractors involved in federal procurements from disclosing contractor bid or proposal information or source selection information (§2102); prohibits any individual from obtaining contractor bid or proposal information or source selection information prior to award (§2102); requires agency officials to report employment contacts regarding non-Federal employment (§2103); and bans for a definitive period certain personnel from accepting compensation from the vendor and the vendor from compensating such certain personnel during this definitive period (§2104). Violations of the statute may result in criminal and/or civil penalties, and administrative actions (e.g., suspension and debarment, cancellation of the procurement, and/or rescission of the contract).

7. SCIENTIFIC AND TECHNICAL INFORMATION SOURCES

The following resources, publications, and websites are referenced in the research topics found in section 9.

7.1 Federal Highway Administration (FHWA)

26-FH1: Edge AI-V2X Integrated Practical Solutions for Congestion Prevention and Mitigation

- NCHRP Research Report 10180 Using Cooperative Automated Transportation Data for Freeway Operational Strategies

Examples of previously funded work:

- An Artificial Intelligence (AI) Based System for Advanced Freeway Data Collection and Analysis, Intelligent Automation, Inc.
- A Wireless Sensor Network with Accurate Time Synchronization and Wide Area Coverage for Traffic Signal Timing Analysis, Intelligent Automation, Inc.
- Simulating Signal Phase and Timing with an Intersection Collision Avoidance Traffic Model, Harmonia Holding Group, LLC
- Edge Server-Based AI Application for Dilemma Zone and Traffic Conflict Events Detection, Aiwaysion Inc.
- Delivering In-Vehicle Messages in Temporary Work Zones, Savari Inc.

26-FH2: Automated Mobile Catch-basin Inspection System

- Ballinger, C.A., and Gade, R.H. 1973, Evaluation of the structural behavior of typical highway inlet grates, with recommended structural design criteria: Federal Highway Administration, 81 p. https://rosap.ntl.bts.gov/view/dot/36583
- FHWA, 2024, Urban Drainage Design Fourth Edition: Hydraulic Engineering Circular No. 22, Publication No. FHWA-HIF-24-006, https://rosap.ntl.bts.gov/view/dot/74311/dot_74311_DS1.pdf
- FHWA, 2024, Catch basin, type 1: FHWA Federal Lands Specification Standard 604-1, 2 p. https://highways.dot.gov/federal-lands/std-drawings/Std604-1.pdf
- FHWA, 2024, Catch basin, type 2, with down drain: FHWA Federal Lands Specification Standard 604-4, 2 p. https://highways.dot.gov/federal-lands/std-drawings/Std604-4.pdf
- FHWA, 2024, Inlet, Type 6B: FHWA Federal Lands Specification Standard 604-7, 2 p. https://highways.dot.gov/federal-lands/std-drawings/Std604-7.pdf
- Law, S.M., Vaccaro, S.J. 1972, Evaluation of catch basin grates: Louisiana Department of Highways, 48 p. Evaluation of Catch Basin Grates Report

7.2 Federal Railroad Administration (FRA)

26-FR1: Mobile High-Power Emergency BESS De-energizer System for Rail Vehicle Propulsion

No additional references.

7.3 Federal Transit Administration (FTA)

26-FT1: Person-Centered, Carefree, Complete Trip Planning - Powered by AI

- Mobility Data – Standards and Specifications for Interoperability (FTA/CUTR Project) https://www.transit.dot.gov/sites/fta.dot.gov/files/2024-08/FTA-Report-No-267.pdf
- Mobility Standards and Guidelines Resource (MSGR) Tool https://maasresources.com/
- Mobility Data Interoperability Principles (MDIP) https://www.interoperablemobility.org/
- MobilityData (Data Standards) https://mobilitydata.org/
- Routing Algorithms – Established Literature
  - Non-Preference
    - (PDF) Optimization of cold chain multimodal transportation routes considering carbon emissions under hybrid uncertainties
    - Robust Optimization of Multimodal Transportation Route Selection Based on Multiple Uncertainties from the Perspective of Sustainable Transportation
    - Optimal routing and request selection for multiple service routes in a demand-adaptive transit system | Frontiers of Engineering Management
  - Preference based
    - [1906.04832] UnLimited TRAnsfers for Multi-Modal Route Planning: An Efficient Solution
    - [2502.14528] Dynamic Preference-based Multi-modal Trip Planning of Public Transport and Shared Mobility
    - A data-driven preference learning approach for multi-objective vehicle routing problems in last-mile delivery - ScienceDirect
- Predicting transit crowdedness (Literature and a source)
  - TransitCrowd: Estimating Subway Stations Demand with Mobile Crowdsensing Data | Data Science for Transportation
  - Crowdsourced Transit predictions - Transit Partners Help

7.4 Office of the Secretary (OST)

26-OS1: Predictive Safety Analytics for Commercial Transport Modernization

- ISO 21448 - Safety of the Intended Functionality (SOTIF): Applies to systems where proper situational awareness is critical for safety, particularly Advanced Driver Assistance Systems (ADAS) and high-level autonomous driving.
- (Proposed) SELF DRIVE Act of 2026: House discussion draft focused on updating federal motor vehicle safety law for vehicles equipped with automated driving systems.
- ISO/PAS 8800: Covers safety-related systems that include one or more electrical and/or

electronic (E/E) systems that use AI technology.

- USDOT Strategic Plan (FY 2022-2026): Federal roadmap emphasizing the shift toward digitally intelligent infrastructure and connected corridors.

26-OS2: Freight Corridor Predictive Intelligence

- Shaping the Future of Freight Logistics: Use Cases of AI in Freight Logistics (2025): Systematic academic review identifying over 70 unique AI use cases across freight logistics and supply chain management.
- Application of Artificial Intelligence in Prediction of Road Freight Transportation (2017): Demonstrates AI and ML applications for forecasting road freight transport trends using Bayesian networks and smoothing methods.
- FHWA Freight Demand Modeling & Data Improvement (SHRP2 C20 Project Results): Outlines ongoing USDOT efforts to enhance freight data and modeling practices for national decision-making.
- Freight Corridor Digital Twin Optimization Market Outlook (2024): Market analysis describing trends and technologies in freight corridor optimization and digital twin markets.
- Automated Freight Corridor Assessment (ATRI/INRIX) (2018): Data-driven approach to identify corridors best suited for autonomous freight operations based on volume, congestion, and incident data.
- TRB / NCFRP Freight Research Collection: Series of reports providing guidance on freight data collection, modeling, and sharing; multiple resources that are foundational to corridor predictive modeling and analytics.
  CSCMP State of Logistics Report (2024): Annual report summarizing freight and logistics trends, technology adoption, cost pressures, and resiliency factors shaping freight corridor operations.
- CSCMP White Paper--The Threat of Resiliency and Sustainability in Global Supply Chain Management: Expectations for 2025: Discusses emerging risks and strategies in global supply chains, highlighting the growing need for predictive intelligence and resilient freight operations.
- TRB / NCFRP Report 38 — Guide for Conducting Benefit-Cost Analyses of Multimodal, Multijurisdictional Freight Corridor Investments (2017): Comprehensive guide for evaluating freight corridor investments using benefit-cost frameworks; relevant to quantifying predictive intelligence benefits.

7.5 Pipeline and Hazardous Materials Safety Administration (PHMSA)

26-PH1: Increase End-of-Life Battery Safety and Recovery of Rare Earth Minerals

- https://www.federalregister.gov/documents/2025/04/18/2025-06836/ensuring-national-security-and-economic-resilience-through-section-232-actions-on-processed-critical
- Example of accident involving end-of-life lithium-ion batteries: https://abc3340.com/newsletter-daily/truck-carrying-batteries-explodes-in-birmingham-lithium-explosion-fire-daniel-payne-hazmat-hazardous-smoke

- Report on the cost to recycle end of life batteries: https://www.sciencedirect.com/science/article/pii/S2405829725000364
- Conductive Gel report from Naval Research Lab: https://www.mdpi.com/2313-0105/11/5/201

26-PH2: Thermal Indicator Coatings for Hazardous Materials Packaging Safety

- Behavior of Thermochromic Coatings under Thermal Exposure; Z. Tatíčková et al., 2023 - https://www.mdpi.com/2079-6412/13/3/642
- Chameleon inspired high temperature thermochromic traffic light type photonic crystal sensors toward early fire detection and visual sensing Q. Shi et al., 2024 - https://www.sciencedirect.com/science/article/abs/pii/S1385894724014529

26-PH3: Self-repairing Hazardous Materials Packaging

- https://pubs.acs.org/doi/10.1021/acs.chemrev.2c00839
- https://www.nature.com/articles/s41586-023-06223-0
- https://www.sciencedirect.com/science/article/abs/pii/S000186862500034X
- Kim S, Jeon H, Koo JM, Oh DX, Park J. Practical Applications of Self-Healing Polymers Beyond Mechanical and Electrical Recovery. Adv Sci (Weinh). 2024 Apr;11(16):e2302463. doi: 10.1002/advs.202302463. Epub 2024 Feb 15. PMID: 38361378; PMCID: PMC11040355
- Introduction: Self-Healing in Chemical Systems | Chemical Reviews
- Autonomous healing of fatigue cracks via cold welding | Nature
- Self-healing packaging films/coatings for food applications; an emerging strategy - ScienceDirect
- https://pmc.ncbi.nlm.nih.gov/articles/PMC11040355/
- eCFR :: 49 CFR Part 178 -- Specifications for Packagings

26-PH4: Improved Response to Lithium-ion Battery Fires

There are many current strategies and methods for extinguishing a lithium-ion battery fire. You can find current PHMSA guidance in the Emergency Response Guidebook (ERG). https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2024-04/ERG2024-Eng-Web-a.pdf

There are also a variety of ideas on best methods/practices, with some demonstrating a clear need for more advanced response techniques:

- NYS-Division of Homeland Security: What to Do If a Lithium-ion Battery Catches Fire
- U.S. Fire Administration: Lithium Ion Batteries
- https://www.fdnysmart.org/be-fdnysmart-when-using-any-devices-powered-by-lithium-ion-batteries/
- https://www.osha.gov/sites/default/files/publications/OSHA4480.pdf

8. SUBMISSION FORMS

This section includes a checklist of requirements for your proposal package.

8.1 Proposal Submission Checklist

Review the checklist carefully to ensure your proposal meets the U.S. DOT SBIR requirements. Failure to meet the requirements may result in your proposal being rejected. ***Do not include this checklist with your proposal.***

_____	Your business has active registrations in both SAM.gov and the SBA SBIR Company Registry, and proof of those registrations are included with Appendices A and B. (Sections 2.1, 2.2, and 3.3.2)
_____	The proposal is limited to only ONE of the research topics in section 9.
_____	The proposal package is submitted according to all requirements found in sections 3, 6, and 8.
_____	All files are labeled using the required naming conventions. (Section 3.2.2)
_____	The Technical Proposal includes all required parts, does not exceed 15 pages, and follows all formatting requirements (Section 3.2.1)
_____	Information on prior Phase II awards is included in the Technical Section, if required. (Section 3.3.1)
_____	Appendix A is complete and contains both required signatures (Sections 3.3.2 and 8.2)
_____	In Appendix B, the technical abstract contains no classified or proprietary information and is limited to 200 words and the space on the template. (Sections 3.3.2 and 8.3)
_____	Appendix C: Contract Pricing Worksheet is complete, and the supporting documents provide the necessary justifications. (Sections 3.3.3, 3.3.4 and 8.4)
_____	The proposed price does not exceed $200,000 unless otherwise indicated in section 9, not inclusive of TABA, and the proposed duration does not exceed six months.
_____	If TABA is requested, the pricing is included in Appendix C, and the supporting TABA quote or other documentation is included with the price supporting documents. (Section 3.5.4)
_____	The proposal reflects that a minimum of two-thirds of the research or analytical effort is being performed by the awardee in Phase I. (Section 1.3.4)
_____	The Technical Section, Appendices A & B and proof of registrations, Appendix C, and contract price supporting documents have been uploaded to the automated proposal submission system. (Section 6)
_____	The Disclosure of Foreign Affiliations form has been completed for the U.S. DOT at https://forms.office.com/g/BmmrYKqhpz as required in section 2.4. *Reminder: If submitting multiple proposals, a separate disclosure form must be submitted for each.*
_____	The proposal is submitted online and received by the U.S. DOT automated proposal website by 3:00 p.m. ET, July 7, 2026. (Sections 3.4 and 6)

8.2 Proposal Signature Page (Appendix A)

A fillable PDF version of Appendix A is available through this link to U.S. DOT's SBIR website. An example of the information required is shown below.

Proposal Information		
Topic No. (see Solicitation):	Solicitation No.: 6913G626QSBIR1	
Topic Title:		
Proposal Title:		
Company Information		
Company:		
UEI #:		
Address:		
City:	State:	Zip:

Offeror Certification

By signing belowand submitting this offer in response to Solicitation No. 6913G626QSBIR1, Topic Number_ _____, I(We) am(are) representing on my(our) 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 of the date of submission. I acknowledge that any intentional or negligent misrepresentation of the information contained in this certification may result in criminal, civil or administrative sanctions, including but not limited to: (1) fines, restitution and/or imprisonment under 18 U.S.C. § 1001; (2) treble damages and civil penalties under the False Claims Act (31 U.S.C. § 3729 *et seq.*); (3) double damages and civil penalties under the Program Fraud Civil Remedies Act (31 U.S.C. § 3801 *et seq.*); (4) civil recovery of award funds, (5) suspension and/or debarment from all Federal procurement and non-procurement transactions (FAR Subpart 9.4 (as deviated by DOT FAR Class Deviation 2025-22) or 2 C.F.R. part 180); and (6) other administrative penalties including termination of SBIR awards.

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

8.3 Project Summary (Appendix B)

A fillable PDF Version of Appendix B is available through this link to U.S. DOT's SBIR website. An example of the information required is shown below.

Project Summary
Abstract (Limited to two hundred words in this space only. The Project Summary of successful proposals may be published by the U.S. DOT and, therefore, must not contain classified or proprietary information.).
Anticipated Results/Potential Commercial Applications of Results.
Keywords

8.4 Contract Pricing Worksheet (Appendix C)

The Appendix C template can be found on the DOT SBIR website in Microsoft Excel format. This template must be used to comply with the requirements in section 3.3.3. Please fill out the spreadsheet as directed in the instructions on the template.

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/faqs). If you have additional questions regarding Appendix C not listed on our FAQ page, please submit those questions via email to:

U.S. DOT SBIR Program
dotsbir@dot.gov

All administrative and Appendix C questions must be submitted no later than 3:00 p.m. ET on Tuesday, June 30, 2026. Questions received after that time may not be answered. The Government reserves the right to address a late question if the Government determines an answer is in its best interest.

9. RESEARCH TOPICS

The FY 2026 SBIR Solicitation Phase I research topics for the participating U.S. DOT Operating Administrations are listed on the following pages. These topics indicate the specific areas for which you may submit SBIR Phase I proposals for consideration. **Your proposal must align with the requirements in one of the topics to be considered responsive.** The topics are not listed in any order of priority.

Each proposal must be based on a unique innovation, limited in scope to one topic, and submitted only under that one topic. Where similar research is discussed in more than one topic, you should choose the topic which appears to be most relevant to your technical concept. You may submit more than one unique proposal to the same or different topics; however, you must not submit the same (or substantially equivalent) proposal to more than one topic. **If you submit substantially equivalent proposals to several topics, U.S. DOT may decline all proposals.**

Topic Number & Title	Estimated Phase I Award*	Estimated Phase II Award**
Federal Highway Administration (FHWA)		
26-FH1: Edge AI-V2X Integrated Practical Solutions for Congestion Prevention and Mitigation	$200,000	$750,000
26-FH2: Automated Mobile Catch-basin Inspection System	$200,000	$1,500,000
Federal Railroad Administration (FRA)		
26-FR1: Mobile High-Power Emergency BESS De-energizer System for Rail Vehicle Propulsion	$200,000	$750,000
Federal Transit Administration (FTA)		
26-FT1: Person-Centered, Carefree, Complete Trip Planning - Powered by AI	$200,000	$600,000
Office of the Secretary (OST)		
26-OS1: Predictive Safety Analytics for Commercial Transport Modernization	$200,000	$500,000
26-OS2: Freight Corridor Predictive Intelligence	$200,000	$750,000
Pipeline and Hazardous Materials Safety Administration (PHMSA)		
26-PH1: Increase End-of-Life Battery Safety and Recovery of Rare Earth Minerals	$200,000	$1,000,000
26-PH2: Thermal Indicator Coatings for Hazardous Materials Packaging Safety	$200,000	$700,000
26-PH3: Self-repairing Hazardous Materials Packaging	$200,000	$750,000
26-PH4: Improved Response to Lithium-ion Battery Fires	$200,000	$1,000,000

* Proposals that exceed the Phase I Estimated Award Amount will not be considered for award.

**The Phase II funding level noted is an estimate only and is subject to the availability of funds, and/or the requirements to accelerate the development of a commercial product or innovation. Any changes to the Phase II funding level listed above will be communicated when instructions for the Phase II process are sent approximately 1 month prior to the end of the Phase I project.

You are encouraged to review section 7 of this solicitation for scientific and technical sources that may be referenced in the respective topic descriptions.

Research topics are organized into the following sections:

- 9.1 - Federal Highway Administration (FHWA)
- 9.2 - Federal Railroad Administration (FRA)
- 9.3 - Federal Transit Administration (FTA)
- 9.4 - Office of the Secretary of Transportation (OST)
- 9.5 - Pipeline and Hazardous Materials Safety Administration (PHMSA)

9.1 Federal Highway Administration (FHWA)

About Us: FHWA's Research, Development, and Technology (RD&T) Program identifies and addresses issues of national significance that other research sponsors cannot or will not address, including areas that require higher complexity, higher risk, longer term research, or specific Federal responsibility. The FHWA RD&T program's activities produce a clear public benefit, support Federal stewardship roles, meet and address current and emerging needs and challenges, and ensure the coordination of highway RD&T activities.

FHWA's RD&T program supports research and development to improve safety; the mobility of people and goods; stimulate growth, productiveness, and competitiveness; reduce congestion; improve durability and extend the life of transportation infrastructure; accelerate project delivery; and provide an approach that serves all road users.

26-FH1: Edge AI-V2X Integrated Practical Solutions for Congestion Prevention and Mitigation

Topic Description

Traffic congestion can be induced by weather, traffic incidents, work zones, planned special events, and other events, and affect traffic efficiency in varying temporal and spatial ranges. While most individual congestion may be local in terms of the scope of their impact, collectively they can significantly impact mobility, safety, and economic activity in the United States. Recent advances in artificial intelligence (AI) and communications (such as V2X (Vehicle-to-Everything), fiber, and satellite) make it feasible to combine edge and cloud computing to enable real-time, adaptive, and timely localized traffic operations. It can also aid in preventing or mitigating congestion, such as advising lane positioning at ramps, work zones, weaving zones, and detour for lane closures.

For example, AI systems can be engineered to deliver real-time detour recommendations in areas with large sporting events to prevent or reduce traffic congestion or to advise optimal driving maneuvers, such as lane changes, based on each vehicle's position and trip plan. These systems can also be designed to receive traffic signal timing and phasing information and share it as approach-specific travel guidance in the form of a countdown timer. It can also produce speed guidance for individual drivers depending on their positions on respective approaches to the intersection. Together, these outcomes can help to optimize overall traffic flow in a wide area to prevent and mitigate traffic queues.

Although many emerging products and services leverage edge computing for traffic management, most primarily focus on in-vehicle or single intersection edge computing rather than a cloud-server edge computing solution. With cloud-edge computing, the computing power, learning capabilities, and decision-making functions are dedicated to processing diverse traffic data collected within a defined geographic area (such as, a one-mile by one-mile zone; or adaptively scoped by impact zone), with the total region defined as an entire city or even larger geographic area. The technical

approach envisioned for this SBIR topic aligns with this latter category, which is cloud-edge computing.

This SBIR topic seeks to develop an AI system to enhance traffic operations by predicting and detecting real-time congestion across local or regional roadway networks, encompassing multiple intersections and roadways. The system will assess traffic conditions and deliver effective operational guidance to target recipients to proactively prevent or mitigate congestion within the impacted zone, thereby curbing its spread to surrounding areas. The system may also recommend better traffic operation strategies to a Transportation Management Center (TMC), and function as a complementary component to enhance existing traffic congestion management. Developing such a system requires real-time processing of diverse local traffic data, rapid generation of operational responses, and secure delivery of the location-specific advisories to relevant recipients within the affected area. This requires advanced parallel data processing and decision-making capabilities, efficient system architectural designs that integrate cloud-edge computing, AI, and V2X technologies, to efficiently partition the data ingestion, parallel computing and decision-making workloads, and establish reliable and secure communication channels. To our knowledge, such integrated solutions are not yet available.

To enable such operational innovations, uncertainties and challenges remain regarding:

1. How to rapidly predict/detect congestion, dynamically define the impact zone, and then generate efficient location-specific operational guidance to direct traffic flow or individual vehicles' trips accordingly;
2. How to effectively partition the AI system's detection, prediction, and decision workloads between edge and cloud computing components;
3. How to efficiently communicate the computing results among edge devices, cloud platforms, and other local infrastructure systems;
4. How to reliably and securely deliver location-specific operational advisories to intended recipients within an impacted zone under low levels of connected-vehicle penetration; and
5. If multiple local-AI agents are involved, how to seamlessly coordinate among them to achieve network-wide benefits.

Key innovations include:

1. Developing an integrated system assembling cloud-edge computing and AI with V2X and other secure communication technologies for real-time location specific traffic congestion mitigation.
2. Demonstrating the system through use cases covering specific temporal-spatial spaces, with estimates in range of communication delays and security risks, and then identifying the best practices of the integration; and
3. Scaling the application and deployment of cloud-edge computing, AI and V2X technologies to network-wide applications in live traffic environment.

The project will develop an innovative system that integrates traffic sensing technologies (e.g., legacy fixed point vehicle detectors and connected vehicle data sources), AI, edge and cloud computing, and diverse communication technologies to deliver the following functionalities:

1. Real-time traffic monitoring and congestion detection/prediction: Rapidly ingesting and processing available traffic data to predict or detect congestion within an impact area, with the scope of the impact zone defined according to specific use cases.
2. Traffic operations optimization and guidance: Generating optimal operational recommendations to prevent or mitigate congestion within a local impact area encompassing multiple intersections and roadway segments prone to recurring or nonrecurring traffic congestion, thereby limiting its spread. Recommendations may include location-specific advisories, such as general guidance (e.g., detour, merge, or continue), more precise suggestions (e.g., lane changes or speed adjustments), and traffic control information from roadside infrastructure (e.g., signal phase and timing countdowns).
3. Human-centered advisory delivery: designing and evaluating advisories through human factors research and testing to ensure usability, comprehension, and effectiveness. Secure communication and dissemination: Delivering secure, location-specific advisories to intended recipients via V2X and other trusted communication technologies, ensuring reliable and targeted information delivery.

The system architecture shall explicitly allocate workloads between edge and cloud computing environments as follows:

- Latency-sensitive tasks (e.g., real-time congestion detection, localized trajectory prediction, and generation of immediate operational advisories, such as speed, lane assignment, or detour recommendation) to be executed at the edge.
- Data-intensive but less time-critical tasks (e.g., long-horizon traffic prediction, AI model training, performance monitoring and network-wide traffic analysis) shall be managed in the cloud.

The system's workload partition and communication technology selection will be designed to ensure privacy, security, regulatory compliance, resilience to connectivity disruptions, and to support AI model lifecycle requirements in mind.

The integrated system assembling cloud-edge, AI, and V2X will complement existing critical transportation infrastructure by leveraging data from these systems without interfering their operations, serving as a complementary solution to existing traffic control infrastructure to mitigate real-time traffic congestion in impacted zones—such as areas surrounding traffic incidents, special events, or major venues (e.g., football stadiums)—where timely and event specific traffic advisories are often absent. This approach shall minimize direct cybersecurity and operational risks to existing critical transportation infrastructure while providing proactive congestion mitigation capabilities.

Proposers are encouraged, but not restricted, to utilize data from legacy sensing sources available through accessible networks. They may also incorporate data from emerging technologies or third-party traffic data feeds. For the Phase I proof-of-concept, archived historical data from a selected citywide transportation network may be used to develop and test algorithms and system architecture, provided the system is designed to transition seamlessly to real-time data feeds during Phase II.

Proposers are further encouraged to leverage existing infrastructure, such as roadside sensing devices, roadside units (RSU), cloud computing, and commercially available secure V2X and other communication technologies to avoid major extra infrastructure requirements. Collaboration with state or local agencies is encouraged to support implementation, access to data sources, and data integration with existing transportation systems.

Proposers are encouraged to make the system function to support the delivery of operational recommendations to recipients with diverse V2X and other secure communication capacities, such as mobile device users, transit and truck fleets, and roadside units, adapting to varying levels of connectivity and remain effective under low connected vehicle penetration conditions.

Desired Outcomes

Phase I

Phase I shall deliver a proof-of-concept prototype system integrating AI algorithm, cloud-edge computing, and V2X communication technologies. The system shall work on archived traffic data and prove the capability to detect local congestion, generate, and then deliver location-specific advisories that would mitigate and contain the spatial growth of congestion. The Phase I system shall be designed to comply with applicable cybersecurity, privacy, and data protection standards and regulations. Use of proven commercial-off-the-shelf (COTS) products is permitted and may be incorporated where appropriate.

No specific congestion type is preferred. Offerors shall demonstrate the detection of **five** major traffic scenarios involving multiple congestion types from historic traffic data using suitable AI methods, and cloud-edge computing architecture, formulate the corresponding location-specific operational advisories, and deliver them to target recipients within the impacted areas using appropriate communication technologies.

The product shall incorporate human-centered design principles to present the same advisory information through multiple communication formats tailored to different users and contexts. Human factors testing is not required during Phase I but will be required in Phase II. These studies will employ experimental designs to evaluate and refine advisory effectiveness, usability, and user comprehension.

Phase I shall use hardware-in-the-loop simulation to assess the feasibility of the architecture, critical components, and assess the benefits of the proposed system in mitigating traffic congestion under the detected primary traffic congestion scenarios.

The Phase I final report shall explain the Edge-AI-V2X system prototype in the following aspects:

- Data sources and transition strategy: Explain the data sources used in Phase I and a clear plan for transitioning from archived historical data to real-time data feeds in Phase II;
- Communication technologies: Identify candidate, ready-to-implement secure V2X and other related communication technologies that may be integrated into the system;

- AI methodologies: AI algorithms for processing data, identifying congestion, and generating congestion mitigation strategies;
- System architecture design: Initial system architecture design for integrating cloud-edge, AI, V2X and other communication, including workloads distribution and data transfer mechanisms among edge, cloud (or cloud-edge) platforms, and receiving terminals;
- Hardware-in-the-loop simulation: HIL simulation design and initial test results for the technical feasibility of the proposed Edge-AI-V2X system prototype
- Field deployment planning: identify candidate regions and potential state/local agencies for field testing the prototype in Phase II, including evidence of collaboration interest and a discussion of how successful deployment would benefit the intended end users and stakeholders.

Phase II

The Phase II shall focus on full system integration, testing, and implementation of the proposed Edge-AI-V2X architecture operating on live traffic data deployed in the selected region(s) in collaboration with partnering state or local transportation agencies. The system will be deployed to evaluate real-world performance, scalability, and operational feasibility.

The Phase II product shall include the following:

- At least one state or local agency shall commit to providing access to live traffic data for testing the product's performance. This will enable the research team and the Government to evaluate the system's computing, communication latencies, data accuracy, cybersecurity risks, and overall performance under real-world operational conditions.
- Comprehensive testing to compare baseline conditions (without Edge–AI–V2X travel advisories) against scenarios in which a defined percentage of drivers receive, accept, and follow the system-generated advisories. This analysis will quantify the potential system-wide benefits of the proposed advisory-based congestion mitigation approach.
- Further refine the system's architecture design by incorporating feedback from a technical advisory panel. The refinement shall include the improvement of AI algorithms, workload partitioning between edge and cloud, and effective utilization of V2X and other communication technologies.
- Enhance the advisory messaging designs through additional human factors testing to improve user comprehension, usability, and regulatory compliance.
- Accumulate knowledge of local traffic congestion patterns, incorporate well-trained AI algorithms to produce real-time congestion mitigation advisories, and securely deliver location-specific advisories via V2X and other communication channels to various receiving terminals (intended recipients), including mobile devices, tablets, roadside units, TMCs and Level 2 and above connected vehicles, located in different positions impacted by the detected traffic congestion event.
- Provide a cost-benefit analysis, including subscription costs for live traffic data feeds, system operation and maintenance costs, and potential revenue streams to sustain long-term sustainability. The analysis shall also assess benefits to road users and transportation systems.

References

- NCHRP Research Report 10180 Using Cooperative Automated Transportation Data for Freeway Operational Strategies

Examples of previously funded work to better understand interest and avoid duplication of effort include:

- An Artificial Intelligence (AI) Based System for Advanced Freeway Data Collection and Analysis, Intelligent Automation, Inc.
- A Wireless Sensor Network with Accurate Time Synchronization and Wide Area Coverage for Traffic Signal Timing Analysis, Intelligent Automation, Inc.
- Simulating Signal Phase and Timing with an Intersection Collision Avoidance Traffic Model, Harmonia Holding Group, LLC
- Edge Server-Based AI Application for Dilemma Zone and Traffic Conflict Events Detection, Aiwaysion Inc.
- Delivering In-Vehicle Messages in Temporary Work Zones, Savari Inc.

26-FH2: Automated Mobile Catch-basin Inspection System

Topic Description

Currently, there is a trend among state and federal regulatory agencies to require that state DOTs perform frequent or regular catch-basin inspections as part of their Nonpoint Discharge Elimination System (NPDES) permits. This is a time-consuming process that includes pulling onto the side of the road, removing the cover grate, and measuring water, sediment, and trash levels. Inspections also are needed to detect catch-basin conditions because failure or clogging can lead to stormwater ponding on the pavement, which can cause hydroplaning accidents and loss of visibility from vehicle splash. Meeting inspection requirements is difficult for state DOTs because they commonly own tens of thousands of catch basins dispersed widely across sprawling road networks. Additionally, the roadside environment can be hazardous with hundreds of fatalities and thousands of injuries every year. Therefore, development of a vehicle with a crash attenuator that carries a multi-sensor boom to collect data by multiple sensors (such as optical, lidar, radar, thermal, and/or radiation) as the vehicle travels past catch basins, preferably at slow to moderate speeds, could provide preliminary inspections at low cost with little danger. The data collected could be used to help train an artificial intelligence (AI) system that would do image and data processing to infer conditions within each catch basin. The system would need testing and calibration to ensure that meaningful measurements could be collected by a vehicle mounted system, and that the measurements taken could be reliably interpreted by an AI system to help focus the efforts of inspection and clean-out teams on the subset of catch basins that require near-term maintenance. This research would improve environmental decision-making and improve highway operations.

Desired Outcomes

Phase I

At the conclusion of Phase I, a final report will be developed to summarize efforts in the development of the sensor array and data processing system. Phase I will culminate with a working scale prototype of the sensor array, examples of image and data processing results, and preliminary design details for a full-scale device. In addition, Phase I will be used to identify potential partnerships with testing/research organizations that can provide independent, third-party evaluations of the full-scale device. Interest from potential manufacturing or deployment partners for moving from product to commercialization may also be explored. By the conclusion of Phase I, the developers will have a path towards a clear commercialization plan for Phase II.

Phase II

Phase II will include the development of a full-scale prototype with road testing and evaluation in a controlled road-side setting, preferably with a state or local agency. The research and testing will determine effectiveness of the sensor array and data interpretation system using results of manual catch-basin inspections. Findings from testing would be used to ensure that results from mobile automated inspections would meet the needs of state DOTs and the requirements of regulatory agencies. In addition, results can be used toward marketing the performance of the device to potential buyers. This phase may also include plans for intellectual property protection.

References

- Ballinger, C.A., and Gade, R.H. 1973, Evaluation of the structural behavior of typical highway inlet grates, with recommended structural design criteria: Federal Highway Administration, 81 p. https://rosap.ntl.bts.gov/view/dot/36583
- FHWA, 2024, Urban Drainage Design Fourth Edition: Hydraulic Engineering Circular No. 22, Publication No. FHWA-HIF-24-006, https://rosap.ntl.bts.gov/view/dot/74311/dot_74311_DS1.pdf
- FHWA, 2024, Catch basin, type 1: FHWA Federal Lands Specification Standard 604-1, 2 p. https://highways.dot.gov/federal-lands/std-drawings/Std604-1.pdf
- FHWA, 2024, Catch basin, type 2, with down drain: FHWA Federal Lands Specification Standard 604-4, 2 p. https://highways.dot.gov/federal-lands/std-drawings/Std604-4.pdf
- FHWA, 2024, Inlet, Type 6B: FHWA Federal Lands Specification Standard 604-7, 2 p.
- https://highways.dot.gov/federal-lands/std-drawings/Std604-7.pdf
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9.2 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 innovative solutions. Safety is U.S. DOT's primary strategic goal and 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 to these ends include stakeholder engagement, project prioritization, cost-effective research procurement, and partnerships with other researchers such as the Association of American Railroads (AAR), the American Short Line and Regional Railroad Association (ASLRRA), industry, labor, and academia.

26-FR1: Mobile High-Power Emergency BESS De-energizer System for Rail Vehicle Propulsion

Topic Description

Rail rolling stock is increasingly adopting high-voltage lithium-ion battery energy storage systems (BESS) for propulsion. The BESS propulsion system provides tractive energy for locomotive or multiple unit trainsets. BESS replaces traditional diesel engines as the main electrical power supplier on a locomotive. Post-accident or during heavy maintenance, these BESS packs can retain hundreds of kilowatts of stored energy that present electrocution, thermal runaway, and fire hazards during human access. There is a need for a mobile, rugged, safe, and interoperable system that emergency responders and trained railroad maintenance personnel can use to reliably off-load (neutralize) a minimum of 400 kW of stored energy from rail propulsion BESS prior to moving, storing, or performing hands-on maintenance. This topic supports the Federal Railroad Administration's safety priorities by reducing risk to responders and maintenance personnel and enabling safer post-accident vehicle handling and repair.

This topic seeks to develop a concept and subsequent prototype mobile system (skid or trailer mounted) that can: safely connect to a damaged or intact rail propulsion BESS (typical HV DC 600–1000 V); discharge or transfer at least 400 kW of stored energy through controlled, monitored means (resistive dump, regenerative transfer to grid or secondary energy sink, or hybrid approaches); operate remotely (to maintain operator standoff); provide comprehensive safety interlocks and diagnostics; and be operable by trained emergency response teams and railroad employees with defined procedures and use of appropriate personal protection equipment. The system should be designed for field ruggedness, rapid deployment at accident scenes, and for routine use in maintenance shops. The intended operational goal after de-energization depends on

the health and state of the BESS. The de-energizer is intended to be used at accident sites or in maintenance shops. It is not intended that the BESS be operational after de-energization at an accident site where the battery modules were damaged. In scenarios where it is used in maintenance shops, it is expected that the batteries be fully functional after de-energization. It is not expected that the recovered energy be stored or reused. However, for cases where the system is used in maintenance shops the recovered energy may be useful to the railroad; reusing the capture energy could be a secondary feature of the system. Additionally, battery pack diagnostics may be a secondary feature for a de-energizer system that will be used in maintenance shops. The system can have applicability for use in the marine and bus transit sectors as well.

Specifications include:

- Minimum continuous stored energy off-load capacity of 400 kW scalable to 1,000 kW.
- Compatible nominal pack voltages that is configurable/adaptable 600–1,000 V DC.
- Peak continuous current range: up to ~1,500 A; dependent on voltage.
- System deployment via trailer or skid mountable mobile vehicle with capability of operating over road and railroad tracks.
- Rapid connect/disconnect high voltage interfaces with standardized adaptors and insulated connectors.
- Safety features should allow for remote operation capability, high voltage isolation and interlocks, ground fault detection, arc-flash mitigation, emergency stop, safety sensors and indicators.
- Operational modes should include controlled resistive discharge, regenerative transfer to grid or local energy sink, or controlled discharge for degraded or damaged packs.
- Communication: secure telemetry for remote control and data logging; capability to integrate with incident command systems.
- Interoperability: adaptors and procedures to support multiple OEM battery access protocols and connectors or defined adapter kits.
- Standards conformance: adherence to applicable electrical and battery safety standards. A full review of recommended standard compliance should be completed in Phase I.
- Environmental consideration: operable outdoors at accident sites. System must be temperature and precipitation tolerant. Rail vehicle maintenance shops are characterized by high ceilings, narrow clearance between maintenance tracks.
- Human factors: the system must have controls and user interface suitable for use by trained emergency responders and railroad employees; equipped with clear status indicators, sensors, alerts, and checklists.
- Maintenance and training: Digital training manual and user guide must be provided. Maintenance and training: modular design for field repair, documented maintenance procedures.
- To the extent possible, system must use commercially available components for manufacturing and maintenance.

The Phase I proposer should identify and document specific comparable systems, vendors, and fielded approaches and summarize gaps vs. rail-specific needs. Current industry solutions include

mobile discharge/load bank systems used in EV test labs and motorsport, but none are commercially available for rail applications.

Partnership with a rail industry stakeholder is required. Rail industry stakeholders can include passenger railroads, such as Amtrak, commuter rail providers/operators (state departments of transportation or contracted operators), freight railroads, rail vehicle manufacturers and battery suppliers providing BESS to rail manufacturers.

Lithium-ion battery chemistries used for rail propulsion are nickel manganese cobalt oxide (NMC), Lithium-ion titanate oxide (LTO), lithium iron phosphate (LFP).

Desired Outcomes

Phase I

The Phase I final report must include:

- A validated concept design and feasible architecture for a mobile BESS off-load system capable of handling a minimum of 400kw of stored energy, including mechanical layout of the system, power electronics approach (resistive, regenerative, hybrid), cooling strategy, and connector/adaptor strategy for rail propulsion BESS interfaces.
- Comprehensive safety standards and regulatory gap analysis identifying all applicable standards and recommended conformance plan.
- Risk assessment and mitigation strategy for accident-scene scenarios such as compromised packs, high impedance faults, thermal runaway risk, and recommended safety features and interlocks.
- Preliminary functional and technical specifications (power, voltage, cooling, interfaces) and high-level cost estimate for a Phase II prototype.
- A commercialization and deployment plan identifying primary customers, use cases, likely procurement paths, and preliminary test/demonstration plan.

Phase II

Phase II will include prototype design refinement and build of one mobile demonstration unit and associated adapter kits, including:

- Full system hardware prototype capable of offloading a minimum of 400 kW with documented performance such as test reports and safety verification.
- Remote operation and monitoring software with logging, incident reporting, and secure communications.
- Detailed operator and maintenance training materials, standard operating procedures, emergency procedures, and a training guide for emergency responders and railroad employees.
- Field demonstration and validation at one or more rail maintenance facilities or controlled accident simulation site(s), with measured performance data and after-action safety assessment.
- A commercialization package: manufacturing plan, unit cost estimates, and pilot agreements or letters of interest from potential customers.

References

No additional references for rail applications.

9.3 Federal Transit Administration (FTA)

About Us: The Federal Transit Administration's (FTA) mission is to improve America's communities through public transportation. We envision a better quality of life for all built on public transportation excellence. The Office of Research, Demonstration and Innovation, which directs FTA's research program, provides industry and policy makers with the information and skills to make good business decisions about transit technology, operational, and capital investments. The program uses research results to identify best practices and shares this information with others who can benefit from it. Through its research, FTA shows a range of outcomes that help direct where future transit investments should be made.

26-FT1: Person-Centered, Carefree, Complete Trip Planning - Powered by AI

Topic Description

Travelling by public transportation can be challenging. This is especially true if the trip 1) may involve more than one mode, 2) is not completed within the traditional 9 am – 5 pm commuting pattern, 3) crosses multiple jurisdictions, 4) is in a rural or frontier area, or 5) changes day to day. Luckily, technology holds great promise in efforts to address the full range of challenges that can stymy even the most seasoned transit user, and which certainly stand in the way of a broader slice of the American population choosing public transportation to meet their needs.

The thoughtful examination of the challenges facing (potential) transit riders is referred to as the Complete Trip. This begins with the conception of the possibility of using transit and includes learning how to: 1) plan for and pay for a trip; 2) travel across the streets as a pedestrian; and 3) know where to go, when to go, and how to adapt to changes. Removing barriers at each step of the Complete Trip can open the potential of transit as a useful choice to many more travelers, with all the attendant benefits to their own wellbeing, and the additional societal benefits.

Current trip planning apps provide today's travelers with a great deal of information; however, they do little to resolve key elements of the Complete Trip, starting with conceiving of transit as an option. Today, a user must choose to investigate the transit option. They then must delve further to learn all the small details that can help complete their trip such as payment, accessibility, and timing.

Currently, the underlying data structures, ticketing APIs, and routing engines for these services remain highly disjointed. This topic seeks a unified, traveler-facing front-end interface that leverages AI to seamlessly synthesize these fragmented backend systems into a single, cohesive user experience.

We believe that a thoughtfully developed, AI-powered system can resolve the challenges of the Complete Trip. By learning a person's preferences and travel needs, an AI tool can provide the user with all the information they need to travel confidently, while also responding to challenges as they

arise in a way that meets that person's needs. A smart system can make transit an easy, logical choice for many more people. This SBIR topic seeks to investigate the idea that an AI system can be developed that would place comprehensive, comprehensible, and actionable information addressing the myriad challenges of the Complete Trip in the hands of travelers.

The tool to be developed must empower travelers across each segment of the Complete Trip, including trip planning and payment, as well as enroute navigation support across the streetscapes, transit stations and vehicles. A successful prototype will empower the traveler to know when to choose transit. It will also use its capacity to learn to recommend a trip plan that best meets the needs of each person, for each trip. This can provide comparable options for the traveler to make an informed decision on whether to choose transit or another mode of travel.

To do so, the system must be able to collect and bring together data from a range of transportation-adjacent sources (e.g., traffic, transit arrival/departure, mode change, pedestrian path condition, cycle path options, etc.). This is a task that requires adherence to existing data standards and necessitates the creation of others. It is also imperative that data be presented in a clear, easy to understand, and actionable way to travelers, whoever they are. Universal Design is essential to ensuring the tool provides independent travel for all users, including those with diverse physical or cognitive needs. Beyond usability, however, this tool must proactively understand and address travel challenges facing people with disabilities as easily as it would for other travelers.

Desired Outcomes

Phase I

A Phase I project will result in a proof-of concept report that describes a prototype AI-powered traveler support system. Desired deliverables for this technology would include research to demonstrate technical feasibility during Phase I and show a path toward Phase II software development culminating in delivery of a software package at the completion of the Phase II contract.

The Proof-of-Concept Report could include a comprehensive literature review for research to demonstrate technical feasibility. An example includes summary on various papers highlighting how given ML methods have been used to solve trip-planning problems similar to this solicitation and a justification on how this work can be extended, improved, or utilized in the business' proposed solutions. The report should also outline the necessary data needed to solve the complete trip problem, including how the data will be collected and then integrated into the final product. Further, to demonstrate a path towards software development, the report should include proof of correctness for proposed trip-planning algorithms and a preliminary sketch/description of the system architecture, data pipeline, and the user-facing application. No code is needed, but documentation of mathematical feasibility and implementation (e.g. algorithm pseudocode, database management system diagram, documentation of software design documentation) is required.

Phase II

Phase II will result in the development of a minimally viable product (MVP) version of the tool. This MVP must demonstrate the following:

Understanding of Requirements

- The broad potential sources of data available to support Complete Trips.
- Diverse user needs and applied principles of multimodality and universal design to ensure the AI system can support a wide range of travelers.

System Design

- An AI system that can address the user needs, create a novel experience, and respond to changes in both user behavior and the mobility data ecosystem.

Prototype and Technical Implementation

- Developed the technical architecture and initial algorithms necessary to integrate the data and user requirements identified in Phase I.
- Produced an interactive demonstration prototype that demonstrates real-time trip planning and personalized updates.

Testing & Validation

- Conducted early usability and performance testing to validate the core functionality and documented how the system performs across sample scenarios.
- Gathered and properly assessed user feedback from sample scenarios to provide support for future improvements.

Documentation

- A Phase II report summarizing the design, prototype capabilities, testing results, and recommendations for next steps beyond Phase II.
- Written software documentation listing dependencies and user instructions that demonstrate well-maintained code.

References

- Mobility Data – Standards and Specifications for Interoperability (FTA/CUTR Project) https://www.transit.dot.gov/sites/fta.dot.gov/files/2024-08/FTA-Report-No-267.pdf
- Mobility Standards and Guidelines Resource (MSGR) Tool https://maasresources.com/
- Mobility Data Interoperability Principles (MDIP) https://www.interoperablemobility.org/
- Mobility Data (Data Standards) https://mobilitydata.org/
- Routing Algorithms – Established Literature
  - Non-Preference
    - (PDF) Optimization of cold chain multimodal transportation routes considering carbon emissions under hybrid uncertainties
    - Robust Optimization of Multimodal Transportation Route Selection Based on Multiple Uncertainties from the Perspective of Sustainable Transportation

        - Optimal routing and request selection for multiple service routes in a demand-adaptive transit system | Frontiers of Engineering Management
    - Preference based
        - [1906.04832] UnLimited TRAnsfers for Multi-Modal Route Planning: An Efficient Solution
        - [2502.14528] Dynamic Preference-based Multi-modal Trip Planning of Public Transport and Shared Mobility
        - A data-driven preference learning approach for multi-objective vehicle routing problems in last-mile delivery - ScienceDirect
- Predicting transit crowdedness (Literature and a source)
    - TransitCrowd: Estimating Subway Stations Demand with Mobile Crowdsensing Data | Data Science for Transportation
    - Crowdsourced Transit predictions - Transit Partners Help

9.4 Office of the Secretary of Transportation (OST)

About us: The Office of the Assistant Secretary for Research and Technology (OST-R), works at the dynamic intersection of new and emerging technologies, transportation data, policy, research and all modes of transportation across the Department. Our mission is to facilitate the transformation of our transportation system–making it safer, more efficient, competitive, and accessible. To do this, we:

- Advance innovation, technology development, and breakthrough knowledge.
- Facilitate research and multimodal research collaboration.
- Foster technology transfer through partnerships both within the Department and with other Federal agencies, academia and private entities.
- Provide decision makers with useful statistics and information of the highest quality and integrity.
- Develop a skilled interdisciplinary transportation workforce for the nation.

OST-R coordinates the Department's research investment, oversees the development of Annual Modal Research Plans, and provides opportunities for research collaboration with public and private sector partners.

26-OS1: Predictive Safety Analytics for Commercial Transport Modernization

Topic Description

The U.S. DOT seeks to partner with the commercial transportation sector to modernize safety and operational efficiency through advanced research and development. This initiative aims to foster a collaborative environment where government and industry work together to apply cutting-edge technology for mutual benefit. The technology portion of this effort will explore AI-driven predictive analytics to assist the industry in moving toward a proactive, prevention-based safety culture.

Current safety methodologies primarily utilize historical data to understand past events. This R&D effort aims to explore how diverse data streams can be leveraged to identify potential safety needs before incidents occur. By identifying patterns early, a data-driven approach can support proactive interventions that enhance safety for all road users while maximizing fleet uptime and supply chain reliability.

A central component of this research is the exploration of "Trusted Intermediary" architectures. Recognizing the importance of data privacy and commercial sensitivity, this approach seeks to design secure frameworks where voluntary industry data (such as telematics) can be fused with public safety records. This system would prioritize data protection, ensuring that safety insights are generated without compromising proprietary information.

The proposed solution will focus on analyzing these combined data streams to provide actionable insights that optimize safety resource allocation. By leveraging cloud-based computing and advanced modeling, the system aims to create a safety ecosystem that reduces preventable incidents. Furthermore, the system will adhere to "explainability" principles, providing clear reasoning for its safety assessments to ensure transparency and build trust among all transportation stakeholders.

This topic seeks tools that optimize the use of predictive analytics in support of the integration, safety, and efficiency of motor carriers. Areas of interest include, but are not limited to, those below.

- **Secure Collaborative Data Frameworks:** Research into "Trusted Intermediary" systems that securely aggregate and anonymize diverse data sets to generate safety insights while maintaining strict privacy and commercial confidentiality.
- **Proactive Safety Indicators:** The use of historical data and real-time external feeds (such as weather and infrastructure conditions) to identify "leading indicators" of safety anomalies, enabling preventative measures that save lives and reduce costs.
- **Resource & Efficiency Optimization:** Tools that allow safety partners to realize significant efficiency gains by focusing educational and support resources on operations with the highest projected need, minimizing disruptions to safe operators.
- **Transparent & Explainable AI:** Development of models that provide understandable, transparent reasons for their assessments, fostering confidence and collaboration between technology providers, carriers, and safety officials.
- **Comprehensive Health Modeling:** Exploration of diverse factors—including maintenance trends and environmental conditions—to create a holistic view of fleet safety health.

Desired Outcomes

Phase I

Phase I shall demonstrate the technical feasibility and deliver a proof-of-concept system design. This includes a high-level architecture for a Trusted Intermediary and a predictive modeling strategy. The design should demonstrate how disparate data elements can be securely harmonized to generate proactive safety insights. Key outcomes will include a validated framework, an initial prototype design, and supporting analyses showing the system’s potential to improve safety outcomes and operational efficiency using AI-driven analytics.

Phase II

Phase II will focus on developing, validating, and demonstrating a fully functional prototype of the predictive safety platform. The effort will transition the Phase I concept into an operational decision-support tool for pilot testing. The model will be built using standardized formats ensuring interoperability to enable broader deployment. Field demonstrations will be conducted to evaluate performance, usability, and the ability to reduce risk. A commercialization and transition plan identifying market pathways, partnerships, and strategies for Phase III scaling will be developed.

The final report will consolidate technical results and lessons learned, summarizing the system's potential for modernizing industry safety.

References

- ISO 21448 - Safety of the Intended Functionality (SOTIF): Applies to systems where proper situational awareness is critical for safety, particularly Advanced Driver Assistance Systems (ADAS) and high-level autonomous driving.
- (Proposed) SELF DRIVE Act of 2026: House discussion draft focused on updating federal motor vehicle safety law for vehicles equipped with automated driving systems.
- ISO/PAS 8800: Covers safety-related systems that include one or more electrical and/or electronic (E/E) systems that use AI technology.
- USDOT Strategic Plan (FY 2022-2026): Federal roadmap emphasizing the shift toward digitally intelligent infrastructure and connected corridors.

26-OS2: Freight Corridor Predictive Intelligence

Topic Description

The Office of the Secretary's Intelligent Transportation Systems Joint Program Office (ITS JPO) is leading and managing this topic through joint ITSJPO and FHWA funding. Freight congestion along national corridors in the United States costs billions annually and weakens supply chain reliability. Existing analytical tools generally rely on historical or static data, offering limited predictive capability. This topic is seeking a Freight Corridor Predictive Intelligence tool. Such a tool would investigate the blending of real-time edge analytics, generative artificial intelligence (AI), and federated learning to enhance both public and private freight operational decision-making and to gain system-wide freight efficiencies. This is a multimodal project that would rely on partnering with other DOT modes (e.g., FHWA, FMSCA, MARAD) and supports the Administration's priorities in AI and freight simultaneously.

Two overarching objectives are desired: 1) develop an AI-enabled predictive system that fuses multimodal data sources to forecast freight bottlenecks and supply chain disruptions along critical U.S. freight corridors; and 2) leverage edge AI processing, synthetic data generation, and federated learning to deliver proactive corridor management tools that not only predict conditions but also provide recommendations for operational interventions (e.g., routing adjustments, dynamic parking utilization, driver messaging) for state and local DOTs and private sector freight operators. (**Note**: Predicting specific precursor events for individual vehicles [e.g., overheating or individual disablements] is out of scope).

Across SBIR phases, the solution will incrementally meet the following high-level specifications:

- Phase I: Demonstrate a functional predictive AI architecture capable of integrating and analyzing combined real-world and synthetic freight datasets, achieving baseline corridor-level prediction accuracy of at least 80% for short-term (30–60 minute) congestion and delay forecasts.
- Phase II: Conduct field pilots along 2–3 representative freight corridors (urban, rural, and intermodal) featuring real-time data ingestion from sensors, GPS, and connected vehicle feeds, and deliver a decision dashboard with automated alerting and visualization capabilities.
- Phase III: Implement and validate system scalability and interoperability with commercial telematics platforms, freight carrier systems, and state and local DOT operations platforms, achieving near-real-time predictive updates (<5 minutes latency) and readiness for larger scale deployment and commercialization.

The proposed solution will meet the following high-level technical parameters:

1) Deploy low-power edge AI devices at strategic freight bottlenecks (e.g., interchanges, bridges) to enable real-time monitoring and analytics with minimal connectivity requirements (For Phase I, physical field deployment is not required; a benchtop hardware prototype or hardware-in-the-loop simulation is sufficient to demonstrate technical feasibility) ;

2) Create the ability to integrate multimodal public and private data sources (including GPS, weigh-in-motion (WIM), weather, work zones, truck parking availability (based on historic parking data and predictive algorithms to forecast parking availability by time of day and day of week), connected vehicle (CV) feeds, non-AV commercial vehicle telemetry, and aggregated, anonymized proprietary commercial datasets) into an integrated predictive intelligence framework. (Note: USDOT anticipates facilitating access to specific publicly available federal freight datasets for training and validation, but proposers remain responsible for formulating the overall integration strategy and independently sourcing private data);
3) Generate synthetic "digital twin" logistics data to model freight flows, corridor performance, and system disruptions for scenario testing;
4) Apply federated learning methods to enhance model accuracy across multiple jurisdictions while preserving data privacy and proprietary logistics information. (For Phase I, a simulated federation (such as two data partitions on the same architecture) is sufficient as an architecture demonstration; multi-party deployment is reserved for Phase II); and
5) Provide a cloud-hosted, web and mobile accessible decision-support dashboard compatible with common enterprise platforms (e.g., ArcGIS, Power BI, Tableau) for visualizing corridor performance analysis.

Desired Outcomes

Phase I

By the end of Phase I, the project will have demonstrated the technical feasibility and proof of concept for the proposed freight corridor predictive intelligence initiative. Key outcomes will include a validated framework, an initial prototype design, and supporting analyses showing the system's ability to forecast freight corridor performance using AI-driven predictive analytics.

- Conceptual Architecture and System Design: Develop a high-level system architecture outlining data elements (traffic, freight, work zones, weather, incidents), predictive modeling, and user dashboard components. The design will show how real-time and historical data streams can be integrated to generate corridor-level insights.
- Prototype Predictive Model (Proof of Concept): Build a preliminary model for a selected freight corridor or segment (an entire interstate corridor is not required; applicants may focus on a defined operational segment, freight bottlenecks along a defined corridor, intermodal connectors, or a port facility or Canada/Mexico border-adjacent segment) to demonstrate how machine learning and data fusion can predict short-term corridor performance metrics such as travel time reliability, congestion probability, and truck delay. (Applicants may use historical, archived datasets combined with synthetic freight datasets or simulated corridor conditions to achieve the baseline 80% accuracy threshold; integration of live operational data is not expected until Phase II. Additionally, a private-sector environment may serve as the primary Phase I use case if designed for future public-sector integration.)

- Data Inventory and Integration Plan: Compile and assess freight, supply chain, and traffic data from public and private sources (e.g., NPMRDS, Freight Analysis Framework, ATRI and system infrastructure data including authorized truck routes, bridge clearance, and weight limits). Develop a data integration strategy defining access methods, availability, and preprocessing steps for Phase II implementation.
- Performance Metrics and Validation Approach: 1) Define measurable evaluation criteria (e.g., accuracy, timeliness, completeness). (Note: USDOT does not mandate a specific mathematical error calculation approach or a preferred definition for 'freight delay' (such as travel time increase or dwell time). Proposers are responsible for defining and justifying these metrics to demonstrate the required 80% baseline corridor-level prediction accuracy. 2) Identify candidate corridors for Phase II validation. 3) Conduct preliminary benchmarking to assess model scalability and sensitivity.
- Commercial and Implementation Readiness Assessment: Evaluate Phase II commercialization pathways, partnerships, and integration opportunities with State DOTs, MPOs, local transportation agencies, and logistics data providers to support transition to a deployable prototype. (Informal discussions and identifying specific potential partners are sufficient to meet the baseline requirements for Phase I; signed Letters of Interest are encouraged but not required.)
- The final report should summarize findings, prototype performance, data gaps, and recommended next steps for Phase II, in accordance with SBIR requirements.

Phase II

Phase II will focus on developing, validating, and demonstrating a fully functional prototype of the Freight Corridor Predictive Intelligence (FCPI) system. The effort will transition the Phase I concept into an operational decision-support platform capable of real-time freight corridor prediction and performance analytics for transportation agencies, freight carries, and logistics partners.

- Develop and integrate an operational prototype that combines multimodal freight datasets (traffic, WIM, GPS, weather, truck parking, and connected vehicle feeds) through a unified predictive analytics framework compatible with DOT and commercial systems.
- Refine and validate predictive models using large-scale, real-world data from 2–3 pilot corridors, targeting defined accuracy for short-term (30–60 minute) forecasts.
- Implement federated and edge AI capabilities to enable distributed model learning and real-time processing while preserving data privacy.
- Deliver a cloud-based, web-accessible dashboard (compatible with ArcGIS, Power BI, etc.) to visualize corridor conditions, predictive trends, and recommended responses.
- Conduct field demonstrations with at least two significant freight corridors that are represented by state DOTs, one regional freight partner, and potentially two private sector freight carriers and logistics providers to evaluate performance, usability, and scalability.
- Develop a commercialization and transition plan identifying market pathways, partnerships, and licensing strategies for Phase III.

Anticipated Phase II Deliverables

- Fully integrated prototype with real-time analytics and dashboard functionality.
- Pilot test reports and validation results from selected corridors.
- Technical documentation and system design materials.
- Performance and evaluation report summarizing model accuracy and system scalability.
- Commercialization and transition plan outlining Phase III market readiness.
- Final Phase II report consolidating technical results and lessons learned.

References:

- Shaping the Future of Freight Logistics: Use Cases of AI in Freight Logistics (2025): Systematic academic review identifying over 70 unique AI use cases across freight logistics and supply chain management.
- Application of Artificial Intelligence in Prediction of Road Freight Transportation (2017): Demonstrates AI and ML applications for forecasting road freight transport trends using Bayesian networks and smoothing methods.
- FHWA Freight Demand Modeling & Data Improvement (SHRP2 C20 Project Results): Outlines ongoing USDOT efforts to enhance freight data and modeling practices for decision-making.
- Freight Corridor Digital Twin Optimization Market Outlook (2024): Market analysis describing trends and technologies in freight corridor optimization and digital twin markets.
- Automated Freight Corridor Assessment (ATRI/INRIX) (2018): Data-driven approach to identify corridors best suited for autonomous freight operations based on volume, congestion, and incident data.
- TRB / NCFRP Freight Research Collection: Series of reports providing guidance on freight data collection, modeling, and sharing; multiple resources that are foundational to corridor predictive modeling and analytics.
- CSCMP State of Logistics Report (2024): Annual report summarizing freight and logistics trends, technology adoption, cost pressures, and resiliency factors shaping freight corridor operations.
- CSCMP White Paper--The Threat of Resiliency and Sustainability in Global Supply Chain Management: Expectations for 2025: Discusses emerging risks and strategies in global supply chains, highlighting the growing need for predictive intelligence and resilient freight operations.
- TRB / NCFRP Report 38 — Guide for Conducting Benefit-Cost Analyses of Multimodal, Multijurisdictional Freight Corridor Investments (2017): Comprehensive guide for evaluating freight corridor investments using benefit-cost frameworks; relevant to quantifying predictive intelligence benefits.

9.5 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. 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.

PHMSA's Office of Hazardous Materials Safety carries out a national safety program, including security matters, to protect against the risks to life and property inherent in the transportation of hazardous materials in commerce by all transportation modes. The office 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. The Office of Hazardous Material Safety seeks to improve the safety and reliability of hazardous material transportation.

26-PH1: Increase End-of-Life Battery Safety and Recovery of Rare Earth Minerals

Topic Description

Shipping end-of-life lithium-ion batteries presents significant safety and cost challenges. These batteries often retain residual, or "stranded," energy that can lead to fires or explosions during transport. This risk drives up shipping costs and, in turn, the cost of recapturing rare earth minerals. Rare earth minerals, such as lithium, are essential to support national security and the economy as stated in E.O. 14272. *Ensuring National Security and Economic Resilience Through Section 232 Actions on Processed Critical Minerals and Derivative Products*[1].

To address this issue, PHMSA is seeking a small business to develop a safe, fast, and cost-effective method for removing residual energy, eliminating the primary hazard and potentially paving the way for regulatory relief and market expansion. PHMSA previously collaborated with the Naval Research Laboratory on the development of a conductive gel designed to neutralize stranded energy and is

[1] https://www.federalregister.gov/documents/2025/04/18/2025-06836/ensuring-national-security-and-economic-resilience-through-section-232-actions-on-processed-critical

now exploring additional strategies or alternative technologies that can be commercialized for broader use.

Desired Outcomes

Phase I

By the end of Phase I, the awardee will produce a proof-of concept or working prototype that clearly demonstrates an effective method for safely removing residual energy from end-of-life lithium-ion batteries to decrease risk in transporting end of life batteries. The final product should be scalable to a variety of battery types and chemistries but can be focused on a single type in Phase I. In addition, the main focus of the end product should be consumer electronics but can be callable to larger forum factors. While the solution does not need to be fully optimized, it should show strong technical feasibility and a clear path toward refinement in Phase II. In addition to technical progress, PHMSA also seeks to see growth in strategic relationships with early adopters, industry stakeholders, and a potential pilot partner, that will support future testing, validation, and commercialization. These outcomes will help accelerate the development of practical, scalable solutions that enhance safety, reduce costs, and support regulatory innovation.

Phase II

In Phase II, PHMSA expects the small business to refine and optimize the proposed product or method with a focus on cost-effectiveness, ease of use, and operational speed. The goal is to move beyond proof-of-concept and develop a solution that is practical for real-world application. In addition to technical advancement, the business should be prepared to initiate pilot testing with early adopters and have established relationships that support the transition to commercialization. These efforts will help ensure the solution is scalable, market-ready, and capable of improving safety and efficiency across the lithium-ion battery supply chain.

References

Example of accident involving end-of-life lithium-ion batteries:

- https://abc3340.com/newsletter-daily/truck-carrying-batteries-explodes-in-birmingham-lithium-explosion-fire-daniel-payne-hazmat-hazardous-smoke
- Report on the cost to recycle end of life batteries: https://www.sciencedirect.com/science/article/pii/S2405829725000364
- Conductive Gel report from Naval Research Lab: https://www.mdpi.com/2313-0105/11/5/201

26-PH2: Thermal Indicator Coatings for Hazardous Materials Packaging Safety

Topic Description

Effective, easy to understand, hazard communication is fundamental to PHMSA's safety mission. Yet, in high-risk transportation events such as fires or thermal events, operators and first responders lack simple, visible failure indicators that signal when hazardous materials packaging is approaching dangerous internal temperatures. While certain hazmat markings are familiar to seasoned HAZMAT professionals, non-HAZMAT-trained responders, such as law enforcement who are frequently the first to arrive on scene, are often less familiar with these markings. This gap, combined with the absence of visual cues about evolving hazards, increases the risk of responder injuries, which are already common among police officers arriving at hazardous materials incidents. An intuitive thermal stress indicator would provide critical early warning of rising internal temperatures, allowing operators and first responders to act well before packaging failure.

PHMSA is seeking the development of a thermochromic coating system that can be applied to the external sides of hazardous materials packaging. The proposed coating would change color in response to defined temperature thresholds, offering a visual indicator of internal thermal stress progression during emergencies. While the solution should not prescribe a specific material class or technology preference, it may consider ceramic-based coatings, polymer composites, or nano-enhanced paints that would integrate temperature-sensitive pigments. The system should be low-cost, lightweight, durable under transport and weathering, and scalable to industrial applications. The solution should not interfere with the outer packaging nor be incompatible with any hazardous material commodities.

The proposed coating must visibly change color at pre-determined temperature thresholds. Color change must be irreversible or long-lasting enough to provide meaningful information to transportation operators and first responders during and immediately after an incident. It must maintain coating adhesion, visibility, and durability under routine operational exposure; and it must be visible under low-light and smoke conditions. The proposed coating must be compatible with certain hazmat packaging substrates such as steel, aluminum, or other composites. Prototypes should undergo bench-scale torch fire thermal testing.

Desired Outcomes

Phase I

At the end of Phase I, the small business will demonstrate a proof-of-concept thermochromic coating based on laboratory results. The coating should be able to demonstrate distinct temperature threshold color changes, providing visible indicators when a material is exposed to rising internal heat levels. The initial testing should demonstrate the coating's adhesion to common substrate materials, its durability under repeated use, and the repeatability of its color-change response under controlled thermal exposure conditions.

Additionally, the small business will include feasibility and initial test data reports that document the different coating formulations tested, their compatibility with potential substrate materials, and a structured plan for scaling the application of the coating to larger surfaces.

Phase II

Phase II will focus on advancing the technology from laboratory proof-of-concept toward full-scale testing. The small business is expected to develop pilot-scale formulations and produce larger area coating samples suitable for evaluation. The coating will be validated through testing under simulated fire conditions, including radiant panel exposure and pool fire scenarios, to determine its performance in realistic emergency incidents. Additionally, the coatings must demonstrate durability under long-term operational stressors such as ultraviolet radiation, weathering, impact, and abrasion. The small business will also engage with transportation end-users such as tank car operators, trucking companies, and emergency response organizations. These end users should be involved in pilot demonstrations to ensure that the coatings meet operational needs and integrate into existing safety practices.

References

- Behavior of Thermochromic Coatings under Thermal Exposure; Z. Tatíčková et al., 2023 - https://www.mdpi.com/2079-6412/13/3/642
- Chameleon inspired high temperature thermochromic traffic light type photonic crystal sensors toward early fire detection and visual sensing Q. Shi et al., 2024 - https://www.sciencedirect.com/science/article/abs/pii/S1385894724014529

26-PH3: Self-repairing Hazardous Materials Packaging

Topic Description

Self-repairing materials are used in construction, automotive, and other industries to repair cracks and other minor flaws. This technology has not been approved or used yet in HAZMAT transportation despite the importance of packaging integrity on HAZMAT safety. While performance packaging standards help ensure packages meet a certain level of robustness, incidents can still occur during transportation when packaging integrity is compromised. Metals can crack/corrode, external forces can cause damage (crushing, punctures, or dents), excessive heat can cause deformation, and materials can simply wear over time. Being able to save on packaging damage could not only increase safety but also save direct costs in the HAZMAT transportation industry.

Research on self-repairing materials explores applications in electronics, polymers, corrosion control, and more.[2] Scientists have even observed nano-scale crack self-repairing in metals under a vacuum.[3] The food packaging industry has advanced research towards implementation of self-repairing packaging, investigating films and coatings for the purpose of food preservation.[4] Research conducted by the National Institutes of Health has shown promising results, specifically with self-repairing polymers.[5] Overall, the foundational research shows promise for self-repairing materials in a variety of applications. By integrating self-repairing polymers into hazardous material packaging, shippers could see a reduction in costs due to extended packaging life, reduced downtime if a package is damaged in transit, and enhanced safety to the public and HAZMAT transportation professionals.

PHMSA seeks a solution that can be used as an application on existing packaging types (e.g., self-repairing coating or other application) or a novel self-repairing packaging material. Proposals may consider both bulk and non-bulk packaging types. The solution must meet existing packaging specifications in section 49 CFR 178, “Specifications for Packaging” and any referenced sections. The offeror should consider existing testing requirements for packaging; the solution must be able to pass existing testing requirements for that packaging type. Packaging for Class 7 (radioactive materials) is excluded from consideration for this topic.

The solution should be cost-competitive with existing commercially available packaging types. The solution must specify whether the material can be used for bulk, non-bulk, or both packaging types. The solution must also specify types of material applicable (i.e., plastic, metal, composite, etc.) and what types of damage can be reduced or mitigated. The solution should consider stakeholder involvement from packaging manufacturers. The material must be able to withstand typical HAZMAT transportation conditions; the offeror should consider which mode(s) may be used for the

[2] https://pubs.acs.org/doi/10.1021/acs.chemrev.2c00839
[3] https://www.nature.com/articles/s41586-023-06223-0
[4] https://www.sciencedirect.com/science/article/abs/pii/S000186862500034X
[5] Kim S, Jeon H, Koo JM, Oh DX, Park J. Practical Applications of Self-Healing Polymers Beyond Mechanical and Electrical Recovery. Adv Sci (Weinh). 2024 Apr;11(16):e2302463. doi: 10.1002/advs.202302463. Epub 2024 Feb 15. PMID: 38361378; PMCID: PMC11040355.

packaging and the relevant forces the packaging may encounter, including any potential damage due to the HAZMAT being transported.

Desired Outcomes

Phase I

The anticipated Phase I outcome is, at a minimum, a proof-of-concept final report demonstrating the feasibility of the proposed self-repairing packaging solution. The outcome may also be a working prototype design or sample of self-repairing packaging solutions along with initial data demonstrating self-repairing ability capable of withstanding HAZMAT transportation conditions.

Phase II

The anticipated Phase II outcome would be a further-developed prototype from the proof-of-concept (at minimum). In Phase II, the small business would further identify potential pilot partners and develop a plan to advance the prototype towards commercialization. Considerations include how to scale production and cost-effectiveness. Deliverables would include a final report documenting the development of the prototype and path to commercialization.

References

- Introduction: Self-Healing in Chemical Systems | Chemical Reviews
- Autonomous healing of fatigue cracks via cold welding | Nature
- Self-healing packaging films/coatings for food applications; an emerging strategy - ScienceDirect
- Kim S, Jeon H, Koo JM, Oh DX, Park J. Practical Applications of Self-Healing Polymers Beyond Mechanical and Electrical Recovery. Adv Sci (Weinh). 2024 Apr;11(16):e2302463. doi: 10.1002/advs.202302463. Epub 2024 Feb 15. PMID: 38361378; PMCID: PMC11040355.
- https://pmc.ncbi.nlm.nih.gov/articles/PMC11040355/
- eCFR :: 49 CFR Part 178 -- Specifications for Packagings

26-PH4: Improved Response to Lithium-ion Battery Fires

Topic Description

Lithium-ion battery fires present a growing safety challenge across multiple transportation modes, particularly as electric vehicles, consumer electronics, and energy storage systems become more prevalent. These fires are notoriously difficult to extinguish, as the fires can propagate and be self-sustaining for hours at high temperatures. Accessing where the fire is located can be difficult, making traditional extinguishing techniques ineffective. After ignition of the battery, it has a higher risk of thermal runaway and reigniting, which can pose serious threats to first responders, the public, and supply chain infrastructure. This research aligns with the U.S. Department of Transportation's innovation priorities and PHMSA's Safety Mission.

The goal of this topic is to support the development of a low-cost, easy-to-deploy solution that can rapidly and reliably suppress lithium-ion battery fires across all modes of transportation. The solution should be effective across a range of battery chemistries and form factors, and ideally scalable for use in field settings by emergency personnel, shippers, and battery recyclers. Specifications of this solution may include rapid extinguishment capability, prevention of reignition, and compatibility with existing safety protocols. Technical parameters should support integration with emergency response workflows, allow for piloting with key stakeholders such as fire departments and battery manufacturers, and demonstrate feasibility for commercialization and widespread deployment.

Desired Outcomes

Phase I

By the end of Phase I, the small business should demonstrate a clear proof of concept for a low-cost, safe, and effective method or tool to suppress lithium-ion battery fires. The solution should demonstrate technical feasibility in extinguishing fires quickly and preventing reignition, even if the concept is not fully optimized at this stage. In parallel, the business is expected to initiate relationships with potential early adopters, such as fire departments, emergency response teams, battery manufacturers, and recyclers, to support future pilot testing and commercialization. These outcomes will lay the groundwork to advance fire mitigation strategies, improve public safety, and enable broader deployment in Phase II.

Phase II

During Phase II, the small business is expected to refine and optimize the fire suppression product or method, focusing on performance, cost efficiency, ease of deployment, and reliability across various lithium-ion battery fire scenarios. The solution should be ready for real-world application and demonstrate consistent effectiveness in extinguishing fires and preventing reignition. In addition to technical refinement, the business should complete or have concrete plans to complete pilot testing in collaboration with fire departments or emergency response units. These pilot efforts will validate the tool's usability in field conditions and help build momentum toward commercialization, broader adoption, and enhanced public safety.

References

There are many current strategies and methods for extinguishing a lithium-ion battery fire. You can find current PHMSA guidance in the Emergency Response Guidebook (ERG).
https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2024-04/ERG2024-Eng-Web-a.pdf

There are also a variety of ideas on best methods/practices, with some demonstrating a clear need for more advanced response techniques:

- NY Division of Homeland Security and Emergency Services Li-ion battery fire guidance
- FEMA Li-ion battery guidance
- FDNY Li-ion guidance: https://www.fdnysmart.org/be-fdnysmart-when-using-any-devices-powered-by-lithium-ion-batteries/
- OSHA Li-ion guidance: https://www.osha.gov/sites/default/files/publications/OSHA4480.pdf