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Federal Railroad Administration

BROAD AGENCY ANNOUNCEMENT

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Federal Railroad Administration
Office of Research and Development

Research Initiatives In Support of Rail Safety

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1 Introduction

1.1 Background

The Federal Railroad Administration (FRA) has a successful history of supporting the development of advanced rail technologies to meet the transportation needs of the country. Over the last few decades, the FRA has provided funding and technical support to facilitate research and to stimulate development of new equipment, infrastructure, and testing technologies to enhance the nation's rail transportation safety and efficiency. These efforts are undertaken in support of the US DOT's mission:

Serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.

The FRA's Office of Research and Development is charged with conducting research and development in support of improved railroad safety and national rail transportation policy. These activities support the objectives of the US DOT, the mission critical needs of the FRA, and the rail industry as a whole, through technology development and demonstration, basic and applied research, and information exchange with the rail industry.

1.2 Purpose

The purpose of this Broad Agency Announcement (BAA) is to solicit a variety of basic and applied technology research projects that will support the strategic objectives of Office of Research and Development and the research needs of the four FRA research divisions:

- Track
- Rolling Stock and Equipment
- Train Control and Communications
- Human Factors

Projects shall be focused on technology development that can be used to achieve safe and efficient freight and passenger rail operations in the US. Such technologies will:

- Reduce the operational and program deployment risks associated with mixed use rail lines;
- Improve safety by reducing human and technology failures;
- Bring about capital cost reductions and economy in producing equipment and facilities;
- Reduce operating costs of rail service by providing more efficient operations;
- Improve the reliability of equipment and infrastructure components by reducing failures and/or reducing false failure detections;
- Enhance the social benefits and/or environmental aspects of rail transportation; and
- Facilitate the development of domestic manufacture of rail equipment and infrastructure components.

Specific research topics for this BAA are contained in Appendix C. Additional research topics may be announced at any time during the open period of this BAA.

2 General Research Areas

The following sections provide a general overview of the research focus within each of the four FRA research divisions. Some of the research areas described in this section may be part of this BAA research solicitation. See Appendix C for specific research topics.

2.1 Track Research

Track and infrastructure failure is the second leading cause of train derailments in the United States. The Track Research Program provides testing and analytical support to fulfill FRA's railroad safety mission, and the related development of performance based track safety standards. A component of the Track Research program is to develop and improve inspection technologies to assess track conditions from mobile platform. As new technologies continue to emerge and train speeds increase, the timely development of technical information, data and expertise is crucial to providing a basis on which to make decisions on issues affecting the safe operation of rail vehicles on U.S. track.

The incorrect interaction between moving vehicles and track is another common cause of derailments in our Nation. By also focusing on track and rain interaction, the Track Research Program examines the influence of track geometry characteristics and vehicle speeds on extreme lateral and vertical dynamic forces and accelerations that can potentially lead to derailment or compromise passenger safety.

As train speeds and density increase, it is the goal of the program to continue to ensure that improved capability and safety is available to the industry when required.

General research areas within the Track Research division include:

- Research that examines the relationships between rail failure risk; and rail wear, rolling contact fatigue, and internal rail fatigue.
- Innovative computer modeling capabilities to improve understanding of derailment scenarios, including vehicle-track interaction, wheel and rail profiles, and contact conditions.
- High-speed non-contact methods for detecting, verifying, visualizing, dimensioning, and sizing of internal rail flaws
- New unique methods to repair internal rail flaws without replacing the full rail section.
- Research to quantify the failure risk of track ballast.
- New approaches or methods that combine multiple available inspection technologies that pinpoint track locations that pose a high-derailment risk
- Research to define a quality track inspection and determine the necessary inspection frequency
- New optimization methods between man and machine to improve safety inspections
- Research to predict progressive and/or sudden failures of track structures
- New mobile methods that measure longitudinal rail stress

- Methods for normalization of the ride quality parameters for various vehicles and speeds.
- Unique methods to quantify the vertical stiffness of the track structure
- New methods to conduct switch condition monitoring
- New inspection technologies that detect track defects before they become failures in service.

2.2 Rolling Stock and Equipment

General research topics within the Rolling Stock and Equipment division include:

- Rail yard / hump yard operations
- Methods to reduce the probability and severity of grade crossings accidents
- Locomotive operating cab environment, displays, controls, crew safety and performance.
- Standardization of the Next Generation passenger railcar and locomotive fleet (up to 125 mph)
- Barriers and benefits to the implementation of automated track and rolling stock inspection systems.
- Barriers and benefits to implementation of Electronically Controlled Pneumatic Brakes (ECP).
- Barriers and benefits to implementation of automated inspection technology for rolling stock.
- Knowledge management, training and oversight for the introduction of new employees.
- Development and implementation of Safety Management Systems for railroad applications
- Development and implementation of natural gas powered locomotives
- Safety and risk assessment of natural gas fuel use in locomotive
- Assessment and identification of standardized components for natural gas locomotive

2.3 Train Control and Communications

Adoption and application of new technology in railroad services is a key focus in the Train Control and Communications Program. General research topics within the Train Control and Communications division include:

- Grade crossing hazard mitigation systems
- Positive train control
- Wireless communication system
- Train tracking system
- Risk assessment & hazardous analysis
- PTC/Communication enabling projects

Grade crossing hazard mitigation systems

Highway rail grade crossings are a major safety and investment issue in achieving increased train speeds. One of FRA's specific objectives is to reduce the number of injuries and deaths resulting from crashes at highway-rail crossings.

New technologies are needed which will protect both the rail and highway users without incurring the disruption of grade crossing closure or the cost of grade separation by bridge or tunnel. Specific issues include the design of highway warning and protection devices, train detection and communication, and

grade crossing obstruction detection sensing and communication. Other areas of particular interest are train detection, intrusion alerts, constant-warning-time logic, train control interface, driver warning, and crossing malfunction response facilitation.

Positive Train Control systems

Positive Train Control (PTC) systems are implementations of an advanced train control concept using new micro-processor based technology to improve safety in the three areas:

- Eliminate train to train collisions
- Reduce over-speed derailments
- Protect roadway workers

Besides safety, FRA has been promoting and sponsoring PTC development and demonstration with the following additional objectives:

- Fulfill regulatory requirement to allow high-speed passenger service above 79 mph in freight territories
- Improve signaling and train control infrastructure
- Promote enabled technologies such as train pacing and moving block operation to improve the operation efficiency and asset utilization

Wireless Communication

Wireless communication, especially for transmitting digital packets, is becoming a very important technology in the railroad operation. With the advent of microprocessors, digital communication is a natural application for communication of information and data among various segments of the operation. Its application extends from end-of-train devices, remote controlled locomotives to the complex systems such as PTC.

PTC/Communication Enabling Projects

For PTC to reach its full potential, additional developments may be needed to expand the versatility and functionality. Some examples are interfacing with dispatching systems to provide train pacing, broken rail detection, virtual block enabling technologies, interacting with smart train technology to constant monitor and broadcast the health of locomotives and trains, better integration with other electronics tools used by the crew and workers for enhanced safety and productivity.

Intelligent Transportation Systems/Connected Vehicles projects

New systems and techniques are needed to integrate active and passive highway-rail grade crossing protection into the nationwide Intelligent Transportation System being developed by USDOT, state governments, auto makers, and infrastructure vendors. There is a great potential for increase in safety

at these locations, but reliable and cost effective solutions for communication and message display schemes are still needed.

2.4 Human Factors

Railroads depend on the adaptability of people, as well as the performance of infrastructure, equipment and control systems to keep the system safe. Railroad operating workers need knowledge, training, tools and alertness to do their jobs properly and to ensure the public, their coworkers' and their own safety.

Human errors now account for more than one third of all train accidents in the U.S. railroad industry. The Human Factors research program aims to improve safety culture in railroad organizations. The Human Factors program has performed pilot trials of organizational safety culture initiatives have shown significant benefits.

The Human Factors program also addresses fatigue, distraction and ergonomics. When train crews are highly fatigued the average total accident cost has been found to be more than triple the overall average cost of accidents. A research focus of this program is assessing fatigue and its relationship with accident risk.

General research topics within the Human Factors division include:

Data and Information

- Motorist behavior at grade crossings
- Human reliability (error) in railroad operations, including automation (e.g., PTC, RCL)
- Ergonomic and environmental issues in railroad operations (temperature, vibration, noise, working conditions, display and control design)
- Workload in railroad operations
- Demographics of rail industry and its implications to safety programs and interventions
- Human performance in locomotive cab with distractions (mobile phones, displays, other personnel, other personal electronics, etc.)
- Effect on human performance of increasing complexity in technology and increasing automation on procedure compliance
- Safety and performance effects of various staffing strategies for locomotive cab, including number and type of staff
- Human-systems design requirements and issues for integration and interoperability of new equipment in next generation locomotive cabs

Modeling and Theory Development

- Models of decision-making for motorists at grade crossings, in particular advanced signal detection theory models (fuzzy logic, etc.), naturalistic decision-making.
- Human performance modeling of railroad jobs including use of automation and high speed operations.
- Models of safety culture in US railroad industry based on FRA research

- Evaluation models for improving utilization, impact and effectiveness of R&D
- Models of staffing required to perform various railroad operations (e.g., operate a locomotive consist)

Application of Knowledge to Safety Solutions

- Development of fatigue risk mitigations based on FRA fatigue data.
- Development of grade crossing risk reduction strategies based on FRA signal detection analyses
- Development of educational tools and techniques to improve safety based on FRA job and cognitive task analyses
- Impact evaluations of education, training, and other safety tools and interventions
- Strategies for bridging gaps between current knowledge and practical applications
- Accident/incident investigation tools
- Development of methodologies, devices, technologies to reduce distracted performance
- Development of procedures and checklists to improve safety and efficiency
- Development of decision aids and cognitive support process to improve safety and efficiency of railroad operations

3 Program Guidelines

This BAA, due to its broad research focus, does not lend itself to the use of a common work statement. As such, no single North American Industry Classification System (NAICS) code (formerly Standard Industrial Classification (SIC) codes), will be issued for the BAA. NAICS codes will be specific to each individual contract award, as determined by the type of activity in which the participant will be engaged.

The Government reserves the right to select for award any, all, part, or none of the proposals received in response to this announcement. This BAA is an expression of interest only and does not commit the Government to pay any concept paper or proposal preparation costs.

This announcement constitutes the public announcement, as contemplated by FAR 6.102(d)(2), and no formal Request for Proposals or other solicitation regarding this announcement will be issued. Requests for same will be disregarded.

By participating in this BAA, the offeror agrees if awarded a Firm-Fixed-Price type contract with milestone payments that the Government's liability for any effort performed shall not exceed the payment amount of the preceding milestone. The offeror shall propose and implement a program consistent with this requirement. If it is determined that the offeror's performance under the contract is not progressing to the satisfaction of the Government, the Government retains the right to commence a process to modify or end performance. This process will require a 60-day notice and may be used in conjunction with FAR clause 52.242-15, Stop-Work Order.

3.1 Schedule

This BAA remains effective for proposal selection for two years from the initial date of issuance with the ability to award contracts for three years. Multiple calls for proposals may occur in conjunction with this BAA. The topics and milestones (Appendix C) published in the initial issuance are firm. In the future, ongoing, new or emerging requirements may necessitate amendment of the BAA to include new or different topics. At any time when new topics are added, Appendix C will be amended to incorporate new topics and milestones associated the time period for submissions. These amendments are expected periodically throughout the effective date of the BAA. The BAA may also have a continuously open period (until closed) in which proposal submissions will not be restricted to a standard 30 day Phase I proposal submission. This BAA and amendments issued thereto will be posted to the Federal Business Opportunities (FedBizOpps) website. It is the responsibility of the participant and interested parties to be aware of BAA amendments by regularly checking Federal Business Opportunities (FedBizOpps) website by registering at www.fbo.gov to receive notifications and updates to this specific solicitation.

3.1.1 Communications Protocol and Data Sources

3.1.1.1 Communications Protocol

Those parties interested in responding to this BAA are strongly encouraged to first contact the FRA Office of Research and Development via phone or e-mail (see below) to discuss the prospective project, prior to devoting resources towards completing the project concept paper. All non-technical inquiries should be directed to the Contracting Officer.

Any exchanges of information must be consistent with procurement integrity requirements of section 27 of the Office of Federal Procurement Policy Act (41 U.S.C. 423, as amended) (see Federal Acquisition Regulation (FAR) 3.104). Communication between participants and FRA is encouraged prior to and throughout the project concept paper phase. After submission of project proposals, all information exchanges of a technical nature will be conducted through the BAA Program Manager and exchanges of a non-technical nature through the BAA Contracting Officer. There shall be no discussion of proposals submitted by other participants nor will evaluation information be discussed.

Participants are advised that any indication of interest, in the affirmative, is not meant to imply nor in any way impart an obligation on the part of the Government that an award will be forthcoming for the offered work or project.

All submittals shall be delivered in electronic format (WORD or Adobe PDF) to the e-mail address listed below.

3.1.1.2 Data Sources & Points of Contact:

BAA Official Documents	www.fbo.gov www.fra.dot.gov www.grants.gov
BAA technical information exchange e-mail address	FRARDBAA@dot.gov
BAA Program Manager, Cameron Stuart	TEL: 202-493-6384 Cameron.stuart@dot.gov
BAA Contracting Officer, Tremayne Terry	TEL: 202-493-6164 Tremayne.terry@dot.gov
Central Contractor Registration	www.bpn.gov/ccr

3.2 Participant Eligibility

This is an unrestricted solicitation. Any responsible source may submit a proposal concept paper for consideration, including, but not limited to, states or local governments, or organizations of state or local governments, universities or institutions of higher education, hospitals, non-profit organizations, private individuals, corporations, and businesses or commercial organizations, except that any businesses owned in whole or in part by the Federal Government are not eligible. Although businesses owned in whole or in part by the Federal Government are not eligible for direct funding they may subcontract with eligible participants. Cooperative arrangements (e.g., joint ventures, limited partnerships, teaming arrangements, or collaboration and consortium arrangements) are permitted and encouraged. All participants must be registered on the Federal Government's Central Contract Registration (CCR) and the Online Representation and Certifications Application (ORCA) systems prior to project award (www.bpn.gov/ccr).

Small, Small Disadvantaged (SD), and Service-Disabled Veteran-Owned Business Concerns, and Veteran-Owned (VO) and Woman-Owned (WO), and Historically Underutilized Business Zone (HUBZone) Small Business Concerns, and Historically Black Colleges and Universities (HBCU) and Minority Institutions (MIs) are encouraged to submit proposal concept papers on their own and/or in collaboration with others. However, no portion of this BAA will be set aside or reserved exclusively for Small, SD, or Service-Disabled Veteran-Owned Business Concerns, or for VO, WO, or HUBZone Small Business Concerns, or for HBCU and MIs.

3.3 Project Qualification Requirements

This BAA solicits research projects in response to specific research topics detailed in this document (Appendix C). The FRA is interested in all research that may lead to safer and more efficient rail systems. However, for the purposes of this BAA program, the FRA will respond only to concept paper submittals that are in direct response to a specific research topic, as defined in Appendix C.

Projects shall be designed to complete basic and applied technology activities, to increase the scientific knowledge base of the rail industry, to exploit the potential of existing technologies, and to address issues that impact the safety and efficiency of rail operations, including high speed rail, in the United

States. Projects designed to develop magnetic levitation (Maglev) technologies, or other non-traditional rail transport modes, will not be considered under this BAA. Transit-oriented research topics such as light rail, trolley, or monorail systems will not be considered. This BAA will not be used to sponsor projects that develop specific products or systems for sale. In the context of the technology readiness levels defined below, this BAA is designed only for projects in Levels 1 through 7, with preference given to those projects that are already advanced to the proof-of-concept testing stage (Level 3).

Technology Readiness Levels	Description
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.
5. Component and/or breadboard validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in simulated operational environment.
7. System prototype demonstration in an operational environment.	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment, such as in a rail vehicle or on an actual track system.
8. Actual system completed and qualified through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of a component of subsystem in its intended system to determine if it meets design specifications.
9. Actual system proven through successful deployment.	Actual application of the technology in its final form and under operational conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of true system development.

Source: GAO/NSIAD-99-162

3.4 Project Funding

3.4.1 Program and Project Funding Limits

Funding for this program is appropriated in the Federal budget for railroad research and development. FRA will make available approximately \$4.0 million during fiscal year (FY 13) for projects determined by the FRA to be technically consistent with the objectives of this BAA and of interest to the Government, and for which adequate funding exists. Awards are subject to the availability of funds.

No funding provision or commitment can be made at the time of award for phased or expanded work or projects beyond the initial or base phase funded at time of award that the applicant may propose in its submissions. In the event future appropriated funds are authorized, FRA may, at its discretion, provide additional funding for phased or expended effort under existing awards.

Awards may be of any dollar value (so long as those amounts do not exceed the total amount available under the BAA), but it is anticipated that most individual awards (or that part of the Government's portion in a cost sharing arrangement) will have dollar values ranging between \$25,000 and \$500,000.

Awards resulting from this BAA will be made based on the evaluation results of a two-phased proposal process. The Government reserves the right to fund all, some, one, or none of the proposals submitted; may elect to fund only part of a submitted proposal; and may incrementally fund any or all awards under this BAA. In either case, the Contracting Officer will have the ultimate authority and responsibility to make final scope determinations for selections of proposals that will not be totally funded to ensure the portion selected meets the solicited requirements. In addition, the Government reserves the right to create and maintain a reserve list of proposals for potential funding, in the event that additional funding becomes available.

All awards are subject to the availability of funds. Offers considered unresponsive to the Government's requests for information in a timely manner, defined as meeting government deadlines established and communicated with the request, may be removed from further consideration.

3.4.2 Cost Sharing

For the purposes of this BAA, cost sharing is a generic term denoting any situation where the Government does not fully reimburse the participant for all allowable costs necessary to accomplish the project under the contract or other award instrument. The term encompasses cost matching, participation in-kind, or other investment of resources as a means of venture sharing in lieu of a formal cost sharing arrangement, third-party in-kind contributions, cost limitations (direct or indirect) and similar concepts. Generally, many forms of cost participation, by their very nature and definition, minimize or negate the opportunity for profit or fee.

Cost sharing by awardees is not mandatory under this BAA, but because of the potential for long-term benefits to those firms or institutions involved in these research, development and demonstration activities, it is FRA's policy to obtain cost participation, whenever possible. This is preferred when FRA supports efforts where the principal purpose is ultimate commercialization and utilization of the

technologies by the private sector, and when there are reasonable expectations that the participant will receive present or future economic benefits beyond the instant contract/agreement as a result of the effort. It is important that research conducted under this BAA be applicable to the development objectives of the program, and that the results of these research activities are practical for deployment within the railroad industry. Projects that include partnerships with, and cost sharing from railroad operators and other industry stakeholders, will facilitate future industry adoption of developed technologies. Such projects are preferred.

3.5 Project Selection Process

This BAA selection process is structured as a two-step process. Project evaluations, discussions, and awards will be managed throughout the open period of the BAA on a continuous basis as funding and Government topics dictate, as per the terms of the specific research topic statement (Appendix C)

3.5.1 Project Concept Papers

The first step of the process is the submission and evaluation of project concept papers. As detailed in Section 4.1, the concept paper provides a brief overview of the research effort, including the current state of development, the next steps in the development plan and rough order magnitude cost and schedule data. Concept papers will be used to gauge applicability of and the Government's interest in the technology research area. All participants must submit a project concept paper in order to be considered for an award.

Discussions between the participant and FRA are required at this point in the process in order to develop or refine project concepts and to avoid unnecessary work efforts, by either party, on project concepts that the Government does not value, or cannot fund.

Concept papers shall be submitted in electronic form via e-mail. FRA will work to complete concept paper evaluations within 60 days of receipt and will notify the participant of final disposition in writing.

3.5.2 Project Proposals

Following concept paper evaluation and discussion, FRA may invite the participant to submit a detailed technical and cost/price proposal for award evaluation. Proposals shall be prepared in accordance with the requirements of Section 4.2. Submissions that are incomplete, materially lacking, or not responsive to the technical requirements of this BAA, may be returned unevaluated, or evaluated as is, without further opportunity for revision, at the discretion of the FRA's evaluation committee.

Project proposals shall be submitted in electronic form via e-mail.

3.5.3 Oral Presentations

FRA may request that participants conduct an oral presentation of the proposal following an initial evaluation. Oral presentations may be conducted in person or via telephone or computer conference at the discretion of FRA. Oral presentations shall be prepared in a technical briefing format following the

requirements of Section 4.3. FRA may ask technical questions for clarification during the oral presentation.

3.6 Intellectual Property Rights

Awards will generally contain detailed provisions concerning patent rights, rights in technical data and computer software, data reporting requirements, and other terms and conditions which may be negotiated as part of the award process.

Participants must describe any limitations on any intellectual property (patents, inventions, trade secrets, copyrights, or trademarks) that will impact the Participant's performance of the contract or impact the Government's subsequent use of any deliverable under the contract. In particular, the Participant must describe the intellectual property in sufficient detail to describe the limitations (Data assertions of the Participant or any subcontractor, potential patent licenses required by the Government, etc.), and to describe why or how the Government can accomplish the stated objectives of this BAA with the limitations described or proposed by the Participant. This information must be included in Volume III, Supplemental Information, of the proposal.

3.6.1 Patents

Participants must list any known patents, patent applications, or inventions which may require the Government to obtain a license should the Participant's proposal be selected for award. If any patent, patent application or invention is owned by the Participant, the Participant must provide a statement, in writing, that it either owns or possesses the appropriate licensing rights to patent, patent application or invention for which the Government may require a license for this program. If an Participant does not own or have license rights to license the Government for any such patent or patent application, the Participant must explain how the Government may obtain a license or whether the Participant plans to obtain these rights on behalf of the Government.

For any patent or patent application listed above, the Participant must provide the patent number or patent application publication number, a summary of the patent or invention title, and indicate whether the Participant is the patent or invention owner. If a patent or invention is not licensed by the Participant, identify the licensor. Be advised that no patent, patent application, or invention disclosure will be accepted if identified in the Data Rights Assertion list described below. Rights in patents, patent applications, and invention disclosures are addressed in the patent rights clause to be included in the contract and therefore, no assertion of limited rights in patents or patent applications will be accepted. The list of patents, patent applications and inventions of this section must be a separate list from the Data Rights Assertion list described below.

3.6.2 Proprietary Data Restrictions

Participants are advised that the proposal concept papers and/or proposals may contain data the participant does not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes. If the participant wishes to restrict such data, the cover page of any and all

submittal documents must be marked with the following legend, and relevant sheets marked as instructed.

This proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed – in whole or in part – for any purpose other than to evaluate this proposal. However, if a contract is awarded to this participant as a result of – or in connection with – the submission of these data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government’s right to use information contained in these data if they are obtained from another source without restriction. The data subject to this restriction are contained in Sheets [insert numbers or other identification of sheets].

Each restricted data sheet shall be marked as follows:

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this document.

To the extent that such restrictions on proprietary data or information would not interfere with the intent of the Government to make the results of the work and projects awarded under the BAA available to all interested parties, and if in conformance with the Freedom of Information Act (5 U.S.C. 552, as amended), the Government will honor those desires.

4 Submittal Requirements

4.1 Project Concept Papers

All project concept papers must respond to a specific research topic (Appendix C). The FRA will not evaluate concept papers that do not respond to a specific research topic. In the case of multiple project proposals from a single participant, a separate concept paper is required for each project. No project will be considered for an award without an approved project concept paper.

Project concept papers shall be prepared simply and economically, and shall provide a concise description of the proposed research project, organized as defined in the following sections. Concept papers shall be no more than 5 pages in length, no less than 10 point type, single-spaced, single-sided letter size pages with 1” margins (minimum). Project concept paper submissions should not include promotional brochures, advertisements, taped recordings, or other extraneous material.

4.1.1 Cover page

Project concept papers shall include a cover page containing the following information:

- Working title of the proposed project
- BAA Research Topic title and reference Number (Appendix C)

- Names, phone numbers, and e-mail addresses for the principal technical and contractual points of contact (person or persons authorized to negotiate on the behalf of the participant and who can contractually obligate the participant organization)
- Primary and secondary, if any, participant organization addresses
- Date of submittal
- Proprietary data restrictions, if any (See Section 3.6)

4.1.2 Technical Approach

4.1.2.1 Background

In this section, the participant shall describe the following:

Mission Statement – Briefly describe the technology proposed for research. Provide a statement(s) that conveys the participant’s vision of the fully developed technology and its impact on the FRA’s research topic.

Description of Need – Describe the specific issue intended to be solved or improved by the technology proposed for research and development. Discuss the proposed application to rail safety and/or efficiency improvement in the United States. Estimate the probability of the rail industry adopting this technology, and provide a rationale for this estimate.

Technology Assessment – Quantify the maturity of the technology in the context of the technology readiness levels detailed in Section 2.2. Provide analytic and empiric evidence to support the assessment. Describe how the proposed research or technology is technically or scientifically innovative with respect to the research topic description.

Development Framework – Describe the development history of the technology, both within the participant’s organization and from other sources, as applicable. Discuss the technical, financial, programmatic, or other significant factors that have impacted the development of this technology to date, both positively and negatively. Provide a technological risk assessment for future development of this technology.

4.1.2.2 Scope of Work

The participant shall describe the general scope of work planned for this research activity. This section shall describe the major research, testing, and analysis activities in sufficient detail to communicate the breadth of activities proposed. A detailed work breakdown structure is not required. The participant shall indicate major progress milestones and associated deliverables as part of this section.

The scope of work shall identify all participants and associated stakeholder groups in the major activities of the project, and shall indicate the estimated work effort required from each participant, expressed as a percentage of the total effort for each activity. In addition, the participant shall identify any third party resource needs that are required during the project. These resources may include Government-furnished equipment.

4.1.2.3 Expected outcomes and impacts

Identify the significant outcomes planned for the project and their impact on the safety and efficiency of the rail industry, including short, medium and long term effects. Describe these outcomes and impacts in the context of the technology readiness levels, and in terms of their impact on the realization of FRA goals as described by the specific research topic.

4.1.2.4 QUAD Chart

Include a Quad chart summarizing the project concept, as per the example and instructions provided in Appendix A.

4.1.3 Qualifications

4.1.3.1 Project Team

List all key participants proposed for the project, including participants from outside the prime participant's organization. Organize the team by organization name and briefly describe each person's roles and responsibilities on the project. Provide a short synopsis of each key person's education, experience, and other qualifications applicable to the proposed project. Provide information on the business type (small, large, or disadvantaged) for each participant organization.

4.1.3.2 Past Experience

Describe the relevant past experience of each organization participating in the project. Identify any publicly available and accessible resources that may provide more details regarding this experience, e.g. public web site links to past or current project documents.

4.1.3.3 Unique Capabilities

Briefly describe any unique capabilities that the participant team possesses that may reduce project risk, may reduce project duration, or may improve project financial performance. Describe these capabilities within the context of the research topic BAA and the proposed project's scope of work.

4.1.4 Schedule and Cost Estimates

Provide milestones for the proposed project that includes start, finish, and major activity completion times. Express milestone dates as the number of weeks from project start.

Provide a rough order magnitude cost estimate. Provide a breakdown of these costs (percentage) for each organization in the project team.

Provide a funding plan for the project. Identify each funding source and their contribution to the whole, expressed as a percentage. Include all anticipated sources, including participant internal sources, Government funds, and other participant organizations.

4.2 Project Proposals

Following review and discussion of the concept paper, the FRA may invite the participant to submit a formal proposal for the project. The project proposal builds upon the contents of the concept paper, as modified through discussions between the participant and FRA. Additional content and more detailed information is required in the proposal document, as described in the sections that follow. Proposal documents are produced to the same formatting requirements as the concept papers, except for a 20 page limit. This 20 page limit for the technical proposal is exclusive of Vol II and Vol III.. Submissions that are incomplete, materially lacking, or not responsive to the technical requirements of this BAA, may be returned unevaluated, or evaluated as is, without further opportunity for revision, at the discretion of the FRA's evaluation committee.

The proposal shall be organized into 3 Volumes, as follows:

Volume I: Technical Proposal

Volume II: Cost and Pricing Data

Volume III: Supplemental Information

Participants are advised that the FRA evaluation of a project for possible award is based solely on the contents of the participant's project proposal document, oral presentation documents (see Section 4.3), and the participant's answers to any technical clarification questions, as transmitted through the Contracting Officer. Furthermore, following proposal submittal, any communication to or from FRA shall be through the Contracting Officer.

It is the policy of FRA to treat all proposals as competitive information and to disclose the contents only for the purposes of evaluation.

Please note that prior to an award, the Government reserves the right to perform a review of past performance. Sources for past performance may include the Past Performance Information Retrieval System (PPIRS), the Federal Award Performance and Integrity System (FAPIS), and Government program managers and contracting officers who are familiar with the participants's relevant past performance may also be contacted.

4.2.1 Cover Page

Project proposals shall include a cover page containing the following information:

- Working title of the proposed project
- BAA Research Topic title and reference Number (Appendix C)
- "Project Proposal" written below the project title
- Names, phone numbers, and e-mail addresses for the principal technical and contractual points of contact (person or persons authorized to negotiate on the behave of the participant and who can contractually obligate the participant organization)
- Primary and secondary, if any, participant organization addresses

- Date of submittal
- Proprietary data restrictions, if any (See Section 3.6)

4.2.2 Volume I: Technical Proposal

4.2.2.1 Background

Proposal documents shall address the same requirements with the concept papers, see Section 4.1.2.1. Address Expected Outcomes (as described in Section 4.1.2.1) in this section of the proposal.

Participants shall explain, specifically, how the proposed technology or method enhances the ability to meet the research topic goals; how it could be incorporated into existing railroad equipment, infrastructure, or operations (to include how major barriers, impediments or obstacles could be overcome or mitigated); and the interface modifications required to accomplish a demonstration. Also explain how its application will bring about an improvement to capital equipment or infrastructure, or operating methods, safety and/or performance improvements. Correlative benefits to general railroad operations, if any, should also be cited, since they can also enhance the feasibility of passenger service added to freight routes. Quantitative support should be provided for assertions made.

Proposals may include a discussion of optional, future phase or phases of work. Such discussion shall be clearly labeled as “optional future phase or phases of work.” The original phase or work shall in no way depend on work described under future phases in order to meet the program criteria. If a future phase or phases are included, a rough order magnitude cost estimate shall be provided as a separately labeled section in the costs and pricing section of the proposal.

Proposals shall include references to past relevant research describing capabilities, work, and significant accomplishments in areas directly associated with proposed research area or in closely related areas. A bibliography of relevant technical papers and research notes that support the technical concepts and innovative ideas described in this proposal shall be included for technical reference.

Mission Statement – Describe the technology proposed for research. Provide a statement(s) that conveys the participant’s vision of the fully developed technology and its intended impact on the FRA’s research topic.

Description of Need – Describe the specific issue intended to be solved or improved by the technology proposed for research and development. Discuss the proposed application to rail safety and/or efficiency improvement in the United States. Discuss the intended stakeholder groups expected to utilize this technology and discuss how each group is expected to leverage this technology to improve safety and operating efficiency. Estimate the probability of the rail industry adopting this technology, and provide a rationale for this estimate.

Technology Assessment – Quantify the maturity of the technology in the context of the technology readiness levels detailed in Section 2.2. Describe the technology readiness in the context of the rail industry (operations, legal, regulatory, etc.). Provide analytic and empiric evidence to support the

assessment. Describe how the proposed research or technology is technically or scientifically innovative with respect to the research topic description.

Development Framework – Describe the development history of the technology, both within the participant’s organization and from other sources, as applicable. Discuss the technical, financial, programmatic, or other significant factors that have impacted the development of this technology to date, both positively and negatively. Provide a technological risk assessment for future development of this technology.

Expected Outcomes and Impact - Identify the significant outcomes planned for the project and their impact on the safety and efficiency of the rail industry, including short, medium and long term effects. Describe these outcomes and impacts in the context of the technology readiness levels, and in terms of their impact on the realization of FRA goals as described by the specific research topic.

4.2.2.2 Statement of Work

A statement of work document shall be prepared as a separate document contained within the proposal submittal. There shall be no company-sensitive or proprietary data included in this document.

This statement of work shall contain the following information:

Work Scope: Describe the work to be accomplished as part of the research project. Include the technology under development, the objectives and goals of the effort, major milestones, and the expected outcomes.

Requirements: Define the work. Separate the work effort into major tasks and subtasks as numbered paragraphs, or in a table. Identify all project reviews, test, demonstrations, and all deliverables resulting from the execution of the project.

Deliverables: All project deliverables should be clearly listed and described.

4.2.2.3 Technical Approach

Participants shall provide a narrative description of work to be performed, organized as it is expected to be performed. The technical approach shall include activities designed to integrate rail industry in the development effort, either through active participation in the technology development or through demonstration and/or testing support. Describe the steps, tasks, and activities necessary to achieve the desired project results. Identify and describe all deliverables, presentations, demonstrations, test, and periodic reports. Describe the quality requirements for the project and identify the processes and/or procedures that will be employed to ensure these requirements are satisfied.

The technical approach shall include a risk assessment. Technical, programmatic, market and other risk elements shall be analyzed for their impact on the project. A scoring or ranking scheme shall be developed to quantify potential impacts. Data shall be presented in a probability/impact chart or other suitable format.

4.2.2.4 Project Management Plan

The proposal shall contain a detailed management plan for the project based upon the following minimum requirements.

Work Breakdown Structure (WBS) – Divide the project requirements into tasks and work packages. Hierarchically organize the project work down to the work package level. A table or chart format is preferred.

Project Schedule – Sequence the project activities, identify and estimate resource requirements and activity durations. Identify the critical path. Present the project schedule as a bar, or Gantt-style chart, including activity relationships (dependencies). Provide a milestone chart for the project illustrating key activities and their expected completion time (weeks from project start). Include intermediate progress reviews, demonstrations or tests, and periodic reporting activities in the schedule. All project deliverables shall be clearly indicated on the project schedule.

Mobilization Plan – In the context of the project schedule, describe the plan to acquire and deploy resources needed for the project, including personnel, facilities, equipment, and other resources, including Government Furnished Equipment (GFE), deemed necessary for project execution.

Organization Chart – Deliver an organization chart for the project illustrating resource roles and reporting relationships. Include all participant organizations. Clearly highlight organizations that are participating in cost sharing activities. Identify the type of business (large, small, disadvantaged, or educational) for each participant organization. Provide resumes (2 page maximum) for all key personnel on the project. Resumes shall be organized in an appendix to the proposal. Resumes do not count toward the 20 page limit for the proposal.

Subcontracts/Teaming/Cost Sharing Management Plan – Identify and describe the participant's plans for subcontracting, teaming, and cost sharing. Clearly identify the roles and responsibilities of all organizations working within the project team, including technical and financial elements.

Testing Plan - Describe the testing requirements, environments and methods needed to assess or demonstrate the suitability of the technology in the railroad environment and to demonstrate the success of the proposed project. Cite railroad companies or other rail-related organizations, such as railroad industry suppliers, that have expressed their willingness to permit and/or support such testing or demonstrations. Letters or statements attesting to an outside organization's interest or commitment to permit and/or support testing or demonstrations should be furnished with the proposal as an attachment. Such letters or statements will not count towards the proposal's 20 page limit.

4.2.3 Capabilities and Experience

Identify and describe the capabilities and experience of key personnel and organizations within the project team as these elements relate to the proposed project specifically and the high speed rail industry as a whole. Describe any relevant technological and scientific, railroad or other industrial or defense capabilities, experience, and resources (or those of its team members) that will serve to

demonstrate its ability to successfully conduct the proposed research or technology advancement project. Describe the team member's (or organization's) familiarity with or position in the railroad community and access to critical resources for the project.

Describe any unique capabilities that the participant team possesses that may reduce project risk, may reduce project duration, and/or may improve project financial performance. Describe these capabilities within the context of the objectives of the BAA and the proposed project's scope of work.

4.2.3.1 QUAD Chart

Include a Quad chart summarizing the project proposal, as per the example and instructions provided in Appendix A. Quad charts shall be submitted electronically in native formats.

4.3 Volume II: Cost and Pricing Proposal

See Appendix B for specific requirements for cost and pricing information content and formatting requirements. Cost and pricing proposals must conform to the requirements in Appendix B and below.

4.3.1 General Requirements

Identify each funding source and their contribution to the whole, expressed as a percentage. Include all anticipated sources, including participant internal sources, Government funds, and other participant organizations.

The cost or pricing portion of the project proposal should contain a cost estimate for the proposed effort to allow for meaningful evaluation and determination of price reasonableness and cost realism. The cost estimate shall account for the entire cost of the project, inclusive of that portion of cost the applicant or other participants would bear in any proposed cost sharing arrangement or other investment of resources, as a means of venture sharing, in lieu of a formal cost sharing arrangement. The cost estimate shall be broken down for each year of the proposed work, and by all years combined. At a minimum, the cost estimate shall include the following information:

Labor - A breakdown of direct labor, by WBS index number, identifying the labor categories or individuals and projected hours, and their associated subtotals.

Overhead and/or fringe - Labor overhead and/or fringe rate(s) and base(s), and cumulative effect on labor costs.

Materials, supplies, and equipment - Description and cost of materials, supplies, and equipment, to include the basis of the cost estimate (e.g., historical data, competitive market quotes, and in house transfers). Specific mention should be made of any highly specialized or costly test equipment or supplies needed to accomplish the project.

Travel and transportation - Breakdown of travel and transportation costs.

Subcontracts - Breakdown of individual subcontracts. State the amounts of time of subcontractor/consulting services to be devoted to the project, including the cost to be charged to the proposed contract/agreement.

ODC - Breakdown of other direct costs (reproduction, computer time, and consultants).

Misc. - Identification of any other direct or indirect cost elements not identified elsewhere. For each indirect rate (identified here or elsewhere), indicate if the proposed indirect rate and allocation base have been approved by a Government audit or cognizant agency for use in proposals and when the rate(s) was approved and the name of and telephone number of the cognizant auditor or approving official.

General and Administrative - G&A rate and base, and cost outcome.

Profit or fee - Generally, the FRA does not anticipate providing profit or fee under contracts awarded under the BAA because of the potential for long-term benefits to those firms or institutions involved in these demonstration activities. However, profit or fee may be proposed, and if proposed, is subject to final negotiations.

Cost Sharing/Cost Participation - Identify extent of cost sharing/cost participation, if any (exclusive of the participant's prior investment), to include the actual dollars or the percentage of the cost share of the proposed research or technology project, to be provided by the applicant, or third party contributors or other Federal funding sources, if allowable; the type and extent of cost limitations (direct or indirect); or the specifics for and extent of similar concepts indicative of cost participation. (Note: The applicant may be required to certify that it has secured the appropriate cost share funding levels, and identify the source of funding.)

The value of any proposed cost participation in the form of participation in-kind or other investment of resources as a means of venture sharing, in lieu of a formal cost sharing arrangement, or third-party in-kind contributions, must be assessed by the Government. (Note: These latter forms of cost participation are best suited for and may only be applicable as the participant's cost share/match in a grant or cooperative agreement award.)

4.3.2 Recommended Procurement Instrument and Pricing Arrangement

Participants shall include a summary of the recommended procurement instrument (e.g., contract, cooperative agreement, or grant) and pricing arrangements (e.g., firm-fixed-price, cost, cost-plus-fixed-fee, etc.) and include the rationale for their use. However, the FRA reserves the right to negotiate and award the types of instruments determined most appropriate under the circumstances. If warranted, portions of resulting awards may be segregated into pre-priced options. It is anticipated that most instruments will be contracts with firm-fixed-price pricing arrangements with milestone payments. It should be noted that cost reimbursable type contractual arrangements are not permissible unless the awardee has an accounting system that has been approved by the Government as adequate to support the determination of costs applicable to the contract. Additionally, they accounting system will be

subject to audit and surveillance during the awardee's performance to provide reasonable assurance that efficient methods and effective cost controls are being used. (See paragraph 4.4.2)

For reference, samples of each type of instrument are included under Appendix D of this BAA. We recommend that all participants examine these documents and encourage them to be familiar with the standard Federal Acquisition Regulation (FAR) clauses included. If selected for negotiation, participants will be expected to be familiar with these clauses. Clauses may vary dependent upon type of business and contract, and the specifics of each individual project.

4.4 Volume III: Supplemental information

4.4.1 Contractor Central Registration (CCR) and Online Representation and Certification Application (ORCA)

To be eligible for award of a contract resulting from this solicitation, participants must be registered in the Federal Government's "Central Contractor Registration" (CCR), AND be registered in the Federal Government "Online Representations and Certifications Application" (ORCA). Both of these separate registrations can be accomplished through the following website:

<http://www.bpn.gov>

NOTE: When properly registered in each of these systems, the participants will receive an automatic acknowledgement confirming successful registration in each system. Without such acknowledgements, registrations are not complete.

4.4.2 Administrative and Audit Offices (applies only to non-Fixed Price contractual arrangements)

Participants shall indicate which audit offices will represent them. For DCAA offices, participants can identify their DCAA office by going to the following website: www.dcaa.mil and entering their ZIP code.

4.4.3 Intellectual Property

Participants shall submit information describing the intellectual property that will be used in the performance of the contract, and any proposed restrictions on the Government's use of the intellectual property. See section 3.6 for additional information.

Participants must provide a good faith representation, in writing, that they either own or possess appropriate licensing rights to the intellectual property that will be utilized for this project. If participants are unable to make such a representation concerning the intellectual property, provide a listing of the intellectual property needed, and explain how and when the participant plans to obtain these rights.

For issued patents or published patent applications, provide the patent number or patent application publication number, a summary of the patent or invention title, and indicate whether the participant is the patent or invention owner. If a patent or invention is in-licensed by the participant, identify the licensor. If a patent application has been filed for an invention that has not been made publicly available

and contains proprietary information, provide the patent application serial number, patent application filing date, a summary of the invention title, and indicate whether the participant is the invention owner. If the invention is in-licensed by the participant, identify the licensor.

4.4.4 Subcontracting Plan

Any participant, other than small businesses, universities, or non-profits, submitting a proposal for an award anticipated in excess of \$650,000 and that has subcontracting possibilities, must submit a subcontracting plan in accordance with FAR 19.704(a) (1) and (2). This information, if applicable, must be included in Volume III, Supplemental Information, of the Phase II full proposal. The plan format is outlined in FAR 19.7. Pursuant to Section 8(d) of the Small Business Act (15 U.S.C. § 637(d)), it is the policy of the Government to enable small business and small disadvantaged business concerns to be considered fairly as subcontractors to contractors performing work or rendering services as prime contractors or subcontractors under Government contracts, and to assure that prime contractors and subcontractors carry out this policy.

A subcontracting plan identifies the participant's approach to awarding subcontracts to small business, small disadvantaged business, women-owned small business, service-disabled veteran owned small business, and Historically Underutilized Business Zone (HUBZone) small business concerns, and Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) on this effort. An approved master subcontracting plan may be submitted in lieu of an individual subcontracting plan. The offeror must demonstrate how small business concerns will be used in the performance of the contract. The plan must also specify how the offeror will identify small business concerns throughout contract performance that can be added to the contract team. The emphasis of the plan must be to maximize small business participation to the maximum extent practicable. The current FRA subcontracting goals are as follows:

<u>Percentage of subcontracted dollars</u>	
Small Business	42.2%
Small Disadvantaged Business	17.8%
Women-Owned Small Business Concerns	8.9%
Service-Disabled Veteran Owned Small Business	3%
HubZone	3%

Note: Provide rationale if these goals cannot be achieved.

4.4.5 Past Performance

Prior to award, the Government reserves the right to perform a review of past performance. Sources for past performance may include the Past Performance Information Retrieval System (PPIRS), the Federal Award Performance and Integrity System (FAPIS), and Government program managers and contracting officers who are familiar with the participants's relevant past performance may also be contacted.

4.5 Oral Presentations

FRA may request an oral presentation following an initial review of the proposal. The participant may submit oral presentation slides at the same time as the project proposal, or wait until FRA requests the presentation.

Oral presentations are an opportunity for the participant to provide higher resolution to the topics discussed in the formal proposal. The presentation shall address technical factors only, not cost or pricing data, and shall not address topics not presented in the proposal submittal. FRA may ask technical clarification questions during the presentation.

Oral presentations will be held at the FRA offices in Washington, DC or they will be conducted using computer/telephone tools. Location and format decisions will be made by FRA.

5 Evaluation and Award Process

The process shall be conducted in accordance with FAR Subpart 35.016 (d) and (e). Participants will be notified of evaluation results via letter.

5.1 Evaluation Criteria

5.1.1 Project Concept Papers

Project concept papers will be evaluated for overall technical value to the Government's area of interest, within the context of available funding. FRA will consider the degree of the potential impact on the realization of research topic goals, the technology readiness level, and the reasonableness of estimated costs for each concept paper submitted. FRA will also consider the participant's capability to perform the work based on the technical approach, background, and referenced resources provided in the concept paper.

FRA may request formal proposals for project concepts that are deemed to have technical value to the FRA's objectives and are found to fit within funding constraints. Project concept papers are not evaluated, or considered, as part of the award evaluation process.

5.1.2 Project Proposals

Proposals will be evaluated solely on the criteria published in this announcement. Oral presentations may be considered a subset of the proposal material and evaluated using the same criteria. Oral presentations will not be evaluated for oral delivery style, polish, or the style or format of the submitted material.

The criteria provided below are listed in order of relative importance:

5.1.2.1 Technical Factors

Responsiveness to BAA Objectives and Requirements

The degree to which the proposed project meets the program objectives of the BAA and conforms to the funding limitations detailed herein. The degree to which the proposal is responsive to the requirements published in this announcement.

Technical Approach

The degree to which the project impacts the realization of research topic goals, including enhancing rail safety, performance, and efficiency aspects of rail operations, maintenance, and/or design.

The degree to which the participant communicates the technological framework for the proposed project, in terms of analytical science, prior development progress, and rail industry application.

The degree to which the proposal provides a reasonable and logical technical approach to the project, integrates the rail industry in the scope of work, provides appropriate reports and deliverables to document progress and outcomes, quality controls, and a realistic project risk assessment.

The completeness of the project management plan in terms of required elements, and the degree to which the participant has prepared the project for the execution phase.

The degree of experience and capability of the project team, including key personnel and team organizational partners, as these elements relate to the project work and influence the project's potential for a successful outcome.

5.1.2.2 Cost and Pricing Factors

Project proposals that are evaluated favorably from a technical perspective, have no outstanding issues or areas for clarification, and are determined to be consistent with the objectives of the BAA and of interest to the Government, will be subject to a cost/price evaluation.

Cost and pricing data submissions shall be evaluated for completeness and reasonableness. FRA will estimate the relative value of work proposed against the estimated costs. FRA will consider the level of proposed cost sharing as part of the evaluation.

5.1.2.3 Past Performance Factors

Technically acceptable proposals that are considered realistic and reasonable in terms of proposed cost, and fee, if applicable, will be subject to a review of past performance information provided by the participant or obtained from sources other than those identified by the participant.

5.2 Awards

A proposal must be acceptable under all evaluation factors to be considered eligible for award. All evaluation factors other than cost or price, when combined, are significantly more important than cost or price alone. Technical evaluation is appreciably more important than cost or price and, as such,

greater consideration shall be given to technical excellence rather than cost or price alone. Cost or price is somewhat more important than past performance and, as such, greater consideration shall be given to cost or price rather than past performance alone.

All awards will be subject to the availability of funds. Only the Contracting Officer can legally commit the Government to the expenditure of public funds under this BAA.

5.2.1 Notifications and Negotiations

All participants will receive written notification of the final disposition of their proposal. If selected for award, the Contracting Officer will contact the participant with further instructions, including negotiation procedures, if needed.

Appendix A – Project QUAD Chart

The Quad Chart is used by numerous Government agencies during briefs. It provides a synopsis of the project objectives and progress, as well as providing a graphical representation of the project. The Quad Chart is one landscape oriented page divided into four quadrants and suitable for use in briefings which help Task Monitors explain your work to others. Emphasis is placed on brevity and factual statements. Also, technical engineering details are not included, as the Quad Chart may be used to brief those who are not technical experts in the art.

Each of the four quadrants that comprise the Quad Chart conveys information on a specific aspect of the project. The first quadrant, located in the upper left-hand corner, comprises visually appealing graphics or pictures that clearly represent the key technological idea(s) or the expected impact of the research. If more than one picture is needed to clearly convey the technological idea(s), then a plurality of pictures may be used. Due to the limited space, the number of graphics and pictures should be limited to a maximum of five. If a plurality of pictures are included, they can be presented in any clear, appealing layout, such as a simple array of pictures or a collage of overlapping of pictures. However, they must fit neatly within the first quadrant. There may be something subtle or non-obvious to the casual observer in one or more of the pictures. If this is the case, graphics, such as red arrows, may be added to bring attention to important aspects of the picture(s).

The second quadrant, located in the upper right-hand corner, includes a brief project description. A bulleted list format is used to present this information. For purposes of brevity, the description should be limited to a maximum of five bullets.

The third quadrant, located in the lower left-hand corner, includes three to five quantitative statements discussing how the project work will revolutionize an area of importance to the safety of railroads, such as preventing derailments and detecting defects. Some questions that may be appropriate to address in this section are: How is the current system or procedure implemented now and with what limitations? What is truly new in your approach which will remove current limitations and improve performance and safety? And how much can performance and safety be expected to improve? As in the second quadrant, a bulleted list format is used to present this information.

The fourth quadrant, located in the lower right-hand corner, includes three to five significant project milestones and the approximate cost or projected cost associated with each of the milestones. The information is depicted on a three year horizontal timeline or in a bulleted list format, as in the second and third quadrants.

The Quad Chart also includes a project title that is clearly visible and centered at the top of the page. The Quad Chart concludes with the name of the FRA Task Monitor in the bottom left-hand corner and the name of the project partner in the bottom right-hand corner.

In order to achieve uniformity, certain fonts and font sizes are used in each of the above sections. All the text on the Quad Chart is placed in a common, clearly legible font, such as Times New Roman or Arial. The project title has a font size between 30 and 36. The text found in the second, third, and fourth quadrants has a font size between 14 and 16. The primary purpose of these limitations is to make the information clearly legible and to limit the amount of information on the Quad Chart.

Quad Charts will be accepted in Microsoft PowerPoint formats only. The Quad Charts are limited to one page, and the file size is limited to 500,000 bytes (0.5 MB). If you are having trouble meeting the size requirements, a possible solution is to reduce the size of the images included in the file.

A sample Quad Chart outline is found on the following page.

The following are the Project Evaluation Questions*:

- What are you trying to accomplish?
- How is it done now, with what limitations?
- What is truly new in your approach which will remove current limitations and improve performance? How much will performance improve?
- If successful, what difference will it make?
- What are the mid-term, final exams or full scale applications required to prove your hypothesis? When will they be done?
- How could this transition to the end user? (FRA/railroads)
- How much will it cost?

*George Heilmeyer Criteria

XYZ System



Project Description:

- ...
- ...
- ...
- ...

Railroad Impact:

- ...
- ...
- ...
- ...

Cost & Schedule:

- ...
- ...
- ...

FRA Task Monitor: TBD

Project Partner:

Appendix B – Cost Proposal Format and Preparation Instructions

The cost proposal must include, at a minimum, two separate sections (provided in one submission): a cost summary, not to exceed two-pages (see ‘A’, below), must precede the detailed cost portion (see ‘B’ below) of the cost proposal. Additionally, include detailed cost submissions for all subcontractors and consultants.

A. Cost Summary

A summary cost proposal must be prepared that includes the cost elements presented in the following table based on 12-month increments. Add as many years to the summary as will be included in the full proposed period of performance. Note: The periods of performance must match the information presented in the Statement of Work. Include the applicable Technology Research Area on all pages of the summary cost proposal.

Cost Element	Year 1			Year 2			Year 3		
	Rate Hrly, Mthly	Quantity No. Hrs, No. Months	Total Amount	Rate Hrly, Mthly	Quantity No Hrs, No. Months	Total Amount	Rate Hrly, Mthly	Quantity No Hrs, No. Months	Total Amount
Direct Labor (List each direct labor category or individual separately)									
ABC Category	\$	XX	\$	\$	XX	\$	\$	XX	\$
Dr XYZ	\$	XX	\$	\$	XX	\$	\$	XX	\$
TOTAL DIRECT LABOR		XX	\$		XX	\$		XX	\$
Labor Burden	Labor Burden Rate	Lbr Burden Applied To: (direct labor \$\$...)	Total Amount	Labor Burden Rate	Lbr Burden Applied To: (direct labor \$\$...)	Total Amount	Labor Burden Rate	Lbr Burden Applied To: (direct labor \$\$...)	Total Amount
Fringe Benefits	%	\$	\$	%	\$	\$	%	\$	\$
Overhead	%	\$	\$	%	\$	\$	%	\$	\$
TOTAL LABOR BURDEN			\$			\$			\$
Material/Equipment	Matl O/H Rate	Matl O/H Applied To: (direct matl \$\$...)	Total Amount	Matl O/H Rate	Matl O/H Applied To: (direct matl \$\$...)	Total Amount	Matl O/H Rate	Matl O/H Applied To: (direct matl \$\$...)	Total Amount
TOTAL MATL/EQUIPMENT	%	\$	\$	%	\$	\$	%	\$\$	
TOTAL TRAVEL COSTS			\$			\$			\$
TOTAL ALL OTHER DIRECT COSTS			\$			\$			\$
TOTAL SUBCONTRACTOR COSTS			\$			\$			\$
TOTAL DIRECT COSTS			\$			\$			\$

G&A OR F&A	G&A or F&A Rate	G&A/F&A Rate Applied to: (total cost \$\$...)	Total Amount	G&A or F&A Rate	G&A/F&A Rate Applied to: (total cost \$\$...)	Total Amount	G&A or F&A Rate	G&A/F&A Rate Applied to: (total cost \$\$...)	Total Amount
TOTAL G&A OR F&A	%	\$	\$	%	\$	\$	%	\$	\$
TOTAL FACILITIES CAPITAL COST OF MONEY (COM) (Attach Completed DD Form 1861)			\$			\$			\$
TOTAL COSTS			\$			\$			\$
Fee or Profit	Fee Rate	Fee Rate Applied to: (total cost, excluding COM...)	Total Amount	Fee Rate	Fee Rate Applied to: (total cost, excluding COM...)	Total Amount	Fee Rate	Fee Rate Applied to: (total cost, excluding COM...)	Total Amount
FEE OR PROFIT	%	\$	\$	%	\$	\$	%	\$	\$
TOTAL COST PLUS FEE			\$			\$			\$

** Note: Itemize any planned items costing greater than \$5,000 (unit cost) immediately following the table; include all equipment/material (greater than \$5000 unit cost) in Total Direct Material/Equipment in table. See Equipment/Government Property - Section 'C' herein.*

B. Detailed Cost (no page limit) Offeror format acceptable provided it includes a detailed cost breakdown of all costs by cost element and SOW tasks based on 12-month increments. The offeror must also provide a narrative to support the requirements in each cost element. In addition, the detailed cost proposal must provide separate cost proposals for each subcontractor or consultant, which includes the same level of details required of the prime offeror. **The detailed cost proposal will include the following three sections: (1) Tabular cost breakdown by cost element and SOW tasks based on 12-month increments; (2) Narrative to support the requirements in each cost element; and (3) Subcontractor cost breakdown, as appropriate.**

Budgeted cost elements should reflect the following:

- a) Individual labor categories or persons (principal investigator, graduate students, etc.), with associated labor hours and unburdened labor rates. Allowable charges for graduate students include salary, appropriate research costs, and tuition. Allowable charges for undergraduate students include salary and research training costs, but not tuition.
- b) Cost of equipment, based on most recent quotations and itemized in sufficient detail for evaluation (see Section 'C' below).
- c) Estimate of material and operating costs.
- d) Travel costs and the relevance to stated objectives; number of trips, destinations, duration, if known, and number of travelers per trip. Travel cost estimations should be based on rates referenced on the General Services Administration's (GSA) per diem web page (<http://gsa.gov/perdiem>).
- e) Publication and report costs.

- f) Consultant fees (indicating daily or hourly rate) and travel expenses and the nature and relevance of such costs.
- g) Computer services.
- h) Subcontract costs and type (the portion of work to be subcontracted and rationale). **Include detailed cost summary.**
- i) Communications costs not included in overhead.
- j) Other Direct Costs.
- k) Indirect costs.
- l) Fee/Profit, if any, which an industrial/commercial organization proposes.

C. Equipment/Government Property.

Contractors generally are expected to provide the equipment needed to support proposed research. Where specific additional equipment is approved for commercial and non-profit organizations, such approved cost elements shall be separately negotiated.

Offerors desiring that the Government purchase the equipment under the proposed effort shall provide a justification of need for the equipment and rationale for why the offeror is unable or unwilling to furnish the equipment. Government purchase of equipment that is not included in a deliverable item will be approved on a case-by-case basis.

Proposals that include Equipment must itemize each item and its respective cost in Volume II – Cost Proposal. “Equipment” is a tangible item that is functionally complete for its intended purpose, durable, nonexpendable, and needed for the performance of a contract. Equipment is not intended for sale, and does not ordinarily lose its identity or become a component part of another article when put into use. Equipment does not include material, real property, special test equipment or special tooling. Further, it is tangible property having a useful life of more than two years and an acquisition cost of \$5,000 or more per unit. The justification for this type of equipment and its cost must be disclosed in the cost proposal to include as applicable:

- Vendor Quote: Show name of vendor and number of quotes received and justification of intended award (i.e. lowest price, best value, etc...).
- Historical Cost: Identify vendor, date of purchase and whether or not cost represented the lowest bid. Include release(s) for not soliciting current quotes.
- Estimate: Include rationale for estimate and reasons for not soliciting current quotes.
- Special Test Equipment to be fabricated by the contractor for research purposes and its cost.

- Standard equipment to be acquired and modified to meet specific requirements including acquisition and modification costs, listed separately.
- Existing equipment to be modified to meet specific research requirements and modification costs. Do not include as special test equipment those items of equipment that, if purchased by the contractor with contractor funds, would be capitalized for Federal income tax purposes.
- Specification as to whether or not each item of equipment will be included as part of a deliverable under a resulting award.

In accordance with FAR 35.014, title of equipment or other tangible property purchased with government funds may be vested in institutions of higher education or with non-profit organizations, whose primary purpose is the conduct of scientific research.

Appendix C – Research Topics

Track Research		
Topic	Title	Closing Date for Concept Papers
FRA-TR-001	Low Solar Absorption Rail Coatings	May 1, 2013
FRA-TR-002	Wheel Load Cycle Tag for Rail	May 1, 2013
FRA-TR-003	High Speed Rail Flaw Detector	May 1, 2013
FRA-TR-004	Laser-Based Mid-Chord Offset Measurement System	May 1, 2013
FRA-TR-005	Automated Rail Turnout Inspection Technology	March 28, 2013
FRA-TR-006	Rail Seat Deterioration Measurement	March 15, 2013
FRA-TR-007	Track Inspection Program Optimization Research	March 1, 2013
FRA-TR-008	Autonomous Track Geometry System Data Handling and Integration into Track Inspection Programs	March 28, 2013
FRA-TR-009	Non-Contact Speed and Distance Technology	March 15, 2013
FRA-TR-010	Ballast Fouling Measurement Tool	March 15, 2013
Rolling Stock and Equipment		
Topic	Title	Closing Date for Concept Papers
FRA-RS-001	Battery Technology for Locomotives	June 1, 2013
FRA-RS-002	Natural Gas Locomotive Research	June 1, 2013
FRA-RS-003	Enabling Technology for 125 mph Next Generation High Performance Passenger Locomotives	June 1, 2013
FRA-RS-004	Acceleration of the Implementation of ECP Brake Technology for Freight and/or Passenger Service	June 1, 2013
FRA-RS-005	Technology to Reduce Risks to Railroad Personnel Performing Rolling Stock Inspections and Maintenance	June 1, 2013

Train Control		
Topic	Title	Closing Date for Concept Papers
FRA-TC-001	DSRC Performance Evaluation in a Railroad Environment	March 28, 2013
FRA-TC-002	Applications for On-board, Real-time Train Location and Inertial Sensors	April 15, 2013
Human Factors		
Topic	Title	Closing Date for Concept Papers
FRA-HF-001	Human Factors Research in Locomotive Cab Systems	June 28, 2013

Track Research

Topic: FRA-TR-001

Title: Low Solar Absorption Rail Coatings

The topic seeks to advance the state of knowledge and technology development in the area of rail coatings or treatments that can reduce the rate of solar heat absorption in steel rails. Rail temperature heating due to solar radiation leads to increased mechanical stresses in the rail system and may cause rail buckling failure of the track structure. Recent empirical studies have shown that relatively minor rail temperature reductions can significantly reduce the risk for rail buckles, thus improving the safety of rail operations. The goal of this research is to develop coating or treatment systems that can reduce peak rail temperatures below critical levels. There is particular interest in systems that can be field-applied or applied at the point of rail manufacturing, and for systems that are cost effective, environmentally friendly and long lasting. Projects that include field testing are preferred.

Topic: FRA-TR-002

Title: Wheel Load Cycle Tag for Rail

This topic seeks to develop technology that can measure the service life of rail in terms of wheel load cycles and, if possible, peak and average wheel loads. The objective is to more closely track the service load of rail segments throughout their lifecycle. It is envisioned that this technology take the form of a tag applied to the rail web. The tag should be programmable with basic rail characteristics and date/location of installation and re-installation. The tag should be readable by a handheld device and should also be designed to be removed and reapplied. The scope of research projects for this topic shall include laboratory demonstration of developed technologies.

Topic: FRA-TR-003

Title: High Speed Rail Flaw Detector

Internal rail defects are a leading cause of train accidents and derailments. Current detection methods and technologies are designed to detect very small internal rail defects at slow speeds. This topic seeks to develop and/or demonstrated non-contact rail flaw detection technology that can detect 25 – 40% transverse rail head defects at passenger rail speeds (79 mph) to facilitate more frequent inspections.

Topic: FRA-TR-004

Title: Laser-Based Mid-Chord Offset Measurement System

This topic seeks to develop new, or adapt existing technologies to perform mid-chord offset measurements of rail profile and alignment at chord lengths up to 124 feet. Traditional string-line technologies are not well-suited for longer chord length measurements due to string sag and other factors. This project's objective is to demonstrate new methods for making these critical rail position measurements using laser or other technologies that provide superior accuracy, reasonable cost, and ease of use. Projects that include participation from railroad companies and their track inspectors are preferred.

Topic: FRA-TR-005

Title: Automated Rail Turnout Inspection Technology

This topic seeks to develop automated turnout inspection technology that can inspect all sizes and types of switches in common use in the US rail system to FRA safety standards. The objective of this research is augment traditional human inspection techniques with advanced technology that can make the inspection process more accurate and efficient. To date there has been limited progress made towards this objective through the adaption of line scan imaging and laser-based geometry measurement systems. These systems are typically rail-vehicle-based and provide some quantitative data from of turnout conditions, but are technology-limited. The focus of this research is to study the applicability of other technologies such as optical scanning, machine vision, and associated comparative algorithms in an attempt to form the technical foundation of a more complete inspection system. The vision of a future system is one that can "scan" the turnout and automatically generate a comprehensive condition report. Ideally, the system should be human-portable and deployed off the rail, thus not interfering with rail operations.

Topic: FRA-TR-006

Title: Rail Seat Deterioration Measurement

Concrete crossties are in widespread use on passenger, freight, and mixed-use track throughout the US. In some installations, there is significant wear under the rail seat. This rail seat deterioration (RSD) can pose a serious safety risk to trains and in some cases as been the root cause of train derailments. Identifying RSD on ties is complicated due to the presence of the rail, fasteners, and pads. Thorough inspections require the disassembly of components and hand-held measurement techniques. This topic seeks to develop technology that facilitates automated methods to detect and quantify concrete tie RSD without disturbing the track.

Topic: FRA-TR-007

Title: Track Inspection Program Optimization Research

The FRA recognizes that track inspection excellence, frequency and latency to repair all play a key role in the efficiency and safety of the U.S. Railroad system. Many factors must be considered when designing and optimizing a track inspection, including:

- The probability of finding a track fault given a certain inspection technique (i.e. different types of manned and autonomous inspection),
- The probability that a track fault, or collection of track faults will cause an accident
- Repair latency and associated risks
- The track use or restriction after a given type of fault is detected, and
- The relative criticality of different types and combinations of track faults

The current research interest is to develop an analytical model that combines all of the aforementioned items, with provision for expansion, to allow researchers and practitioners to study the impact of inspection and repair variables on the safety of railroad operations.

Topic: FRA-TR-008

Title: Autonomous Track Geometry System Data Handling and Integration into Track Inspection Programs

Autonomous inspection systems are being developed and deployed to increase the frequency of data collection and to reduce the costs associated with track inspection. The FRA has developed two prototype Autonomous Track Geometry Inspection Systems (ATGMS) for research and demonstration, and the rail industry has begun to acquire similar technology. There are significant technical challenges associated with the volume, accuracy, and frequency of data produced by autonomous systems that must be resolved in order for these technologies to reach their full potential to increase safety and meet efficiency goals. This topic seeks to develop technologies that can be applied to ATGMS data to improve the usefulness of the inspection technology and allow for rapid adoption by the rail industry.

- Database Design: efficient organization and storage of ATGMS data sets, allowing for data reduction and access from third parties using standard industry protocols.
- Multi-Set Data Alignment: automated alignment of track geometry data sets from the same section of rail track, accommodating differences in sampling frequency and intermediate divergent routes.
- Geo-Location: automated translation of geo-located (lat/long) data to railroad reference standards (division, subdivision, Track number, milepost, foot).
- Automated Filtering: automated filtering of erroneous data based on signal processing and business rules.

- Statistical Data Analysis: analysis routines to reduce the data (single and multiple data sets) into manageable and meaningful information based on exception calculations, track degradation/improvement, and other factors.
- Data Accuracy and Repeatability: statistical analysis of data and the frequency of data collection and other factors to determine the level of data accuracy and repeatability required to ensure track safety and to development minimum inspection intervals.

The FRA prefers to accomplish this research as a single scope of work, however, FRA will consider partial responses from highly qualified parties. FRA strongly encourages active teaming arrangements with railroad operators for all aspects of this work.

Topic: FRA-TR-009

Title: Non-Contact Speed and Distance Technology

This topic seeks research and development of non-contact speed and distance systems to replace traditional axle-mounted encoders used to drive measurement system sampling routines. The objective is to use these non-contact sensors for autonomous measurement systems, i.e. ATGMS, to eliminate the need for system interfaces to the rail vehicle running gear, improve accuracy, and to eliminate the need for periodical calibration due to wheel wear. Non-contact systems must have low power requirements to be compatible with self-powering autonomous measurement systems and must have the potential to be price-competitive with current technologies. Development and demonstration projects should include testing system accuracy against standard systems. The FRA owns a prototype, LIDAR-based system that can be made available for use by researchers. This system produces highly accurate velocity data, but does not meet FRA goals for low power consumption and does not provide a distance pulse output to drive a rail-based measurement system. Additional information about this system can be made available to researchers during the concept paper review phase of this procurement.

Topic: FRA-TR-010

Title: Ballast Fouling Measurement Tool

This topic seeks to develop new, or adapt existing technologies to quantify ballast fouling for use by railroad track inspectors. The developed system must be able to make the required measurements without disturbing or removing any ballast. The proposed tool must be highly portable and be able to be carried by one person. The outputs of the tool should provide a percentage of fouling materials present over a unit volume of ballast. Other measurable properties of the ballast such as; ballast depth, ballast void ratio, moisture content, dielectric constant, electrical conductivity, ballast grain size, particle distribution and shape, is not required but would be beneficial.

Rolling Stock and Equipment Research

Topic: FRA-RS-001

Title: Battery Technology for Locomotives

This topic seeks to advance the state of knowledge regarding battery technologies and their application to railroad locomotives. Research shall focus on evaluating the applicability of various battery technologies for use as a locomotive power source. Specific technical areas of interest include:

- Chemistry type
- charging capacity/rate
- discharge rate
- fire safety
- crashworthiness needs – protection on board to ensure a normal railroad environment impact and collision doesn't result in catastrophic failure of the ESS,
- After collision handling processes – how should the ESS be removed, inspected, disposed after collisions
- Maintenance and inspection
- Life cycle cost
- Service life based on charging/discharge rate.

It is desirable that the researcher work with railroads, service providers (State DOT) or, locomotive OEM to execute this project. This research activity will result in a report that will be widely disseminated to the railroad industry and public at large.

Topic: FRA-RS-002

Title: Natural Gas Locomotive Research

This topic seeks to advance the state of knowledge with regard to the use of natural gas as a locomotive fuel in terms of safety and performance issues. Research shall investigate crashworthiness and survivability of LNG/CNG tanks, inspection and maintenance practices (routine, and after incidents/accidents), post-derailment inspection and handling, and fire suppression systems in the context of current FRA safety regulations. Results shall identify regulatory changes needed for wider implementation of natural gas fuels in the rail environment. Additional research areas include understanding the training required for railroad employees and first responders to safely interact with natural gas fuels and equipment, interoperability and standards for safety control systems, fuel distribution systems and emergency shut-off systems. Finally, research is needed to understand the effective range of LNG and CNG in locomotive applications and to identify and to quantify the type of emissions produced by natural gas and remediation technologies necessary to meet environmental standards.

Topic: FRA-RS-003

Title: Enabling Technology for 125 mph Next Generation High Performance Passenger Locomotives

This topic seeks to identify the technologies which will best enable the performance of next generation passenger locomotives. Known technical barriers include reducing the un-sprung mass of a locomotives, implementing technologies and systems which achieve Tier 4 emissions requirements, and developing domestic supplies for tractive power electronics. It is strongly suggested that interested bidders from partnerships or teams which include current locomotive manufacture and current technology providers. Proposals should include a statement of the problem to be solved or opportunity to be addressed, a description of the enabling technology proposed and why it is believed that it would be successful. A “roadmap” which would provide a high level outline of the major steps, beyond this exploratory research, which would be necessary to evaluate, demonstrate, refine, develop and implement the technology proposed, should be included. The participant shall provide clear indications of the resources, technology and/or intellectual property that will contributed to the effort.

Topic: FRA-RS-004

Title: Acceleration of the Implementation of ECP Brake Technology for Freight and/or Passenger Service

Electronically Controlled Pneumatic (ECP) brake technology has been proven to improve both safety and performance of trains. However, implementation has been slowed by a variety of factors. Some are technical, however others are associated with the capital investment required, the allocation of both costs and benefits from implementation, the challenges associated with implementation which now require entire trains to be ECP equipped and perhaps even all trains operating over a route, to be equipped to accrue the benefits of implementation.

The FRA seeks to identify and evaluate viable concepts for accelerating the implementation of ECP brakes, throughout the industry, . To be accepted for evaluation, a proposed concept must include a statement of the problem to be solved or opportunity to be addressed, a description of the enabling technology proposed and why it is believed that it would be successful. Proposals should also include a “roadmap” which would provide a high level outline of the major steps, beyond this exploratory research, which would be necessary to evaluate, demonstrate, refine, develop and implement the technology proposed. The participant shall provide clear indications of the resources, technology and/or intellectual property that will contributed to the effort.

Topic: FRA-RS-005

Title: Technology to Reduce Risks to Railroad Personnel Performing Rolling Stock Inspections and Maintenance

This topic seeks to identify the risks to personnel associated with current rolling stock inspection and maintenance practices and identify and evaluate methods to reduce those risks with the implementation of new technologies and processes. This could include such innovations as systems which inspect rolling stock, facilitate maintenance and either assist in or perform part or all of such tasks as coupling and uncoupling existing railcars and brake lines between cars. The FRA is also interested in learning about techniques to accelerate the introduction of risk reducing technologies and processes associated with rolling stock inspection, maintenance and operation. To be accepted for evaluation, a proposed concept must include a statement of the problem to be solved or opportunity to be addressed, a description of the enabling technology proposed and why it is believed that it would be successful. Proposals should also include a "roadmap" which would provide a high level outline of the major steps, beyond this exploratory research, which would be necessary to evaluate, demonstrate, refine, develop and implement the technology proposed. The participant shall provide clear indications of the resources, technology and/or intellectual property that will contribute to the effort.

Train Control Research

Topic: FRA-TC-001

Title: DSRC Performance Evaluation in a Railroad Environment

This topic seeks to advance the state of knowledge and technology development in the area of connected vehicles rail communication systems. A wireless protocol and hardware set exists for low latency wireless communication for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) schemes and has been well-studied for highway vehicle applications. Highway-rail crossings present some unique operational environments and constraints that have not yet been evaluated. These include protection of active and passive grade crossings, protection against side of train collisions, high speed trains, 30+ second warning timings, variable crossing geometries with often limited sight distance, and environments of high electromagnetic interference. Research projects shall evaluate the performance of the Dedicated Short Range Communications (DSRC) hardware set and other pertinent technologies for Connected Vehicles highway-rail grade crossing application, conduct modeled analysis and empirical measurements, and produce a feasibility analysis of the suitability of DSRC for rail application.

Topic: FRA-TC-002

Title: Applications for On-board, Real-time Train Location and Inertial Sensors

FRA is currently funding the development and testing of a sensor suite designed to measure train position to a high level of accuracy and precision. The integrated sensor suite includes an accelerometer, magnetometer, gyro, and a global positioning system. These sensors are installed at both the front and rear of the train and connected to a processor via a radio data link.

This topic seeks innovative research projects that can leverage this on-board suite and data stream for alternative purposes. The objective is to maximize the utility of this equipment for rail safety and efficiency. Partnership with a freight or passenger railroad is highly desirable.

Human Factors Research

Topic: FRA-HF-001

Title: Human Factors Research in Locomotive Cab Systems

FRA seeks to improve system designs and integration of advanced technology equipment in locomotive cabs by including human capabilities and limitations in the design space for new solutions. The goal is to reduce risk of human error with introduction of new control and display technologies in the locomotive cab. Research interests include systems design specifications, impacts of technology on human performance, and the impact of technology on safe and efficient locomotive cab operations in the following areas:

- Increasing technological complexity and system automation and the need for improved operational procedures to ensure safe and efficient human performance
- Systems, processes and tools to improve decision-making
- Defining human information requirements, communications methodologies and systems to ensure effective communication within the train and between the train and external interfaces, e.g. dispatching centers
- Integration and interoperability of cab equipment and the effect of such system designs on human performance, operational efficiency and system safety
- Assessment of the effects of operating cab automation, display integration, and information flows on human performance
- Risk assessment and prediction of the unintended consequences of advanced technologies and automated technologies on human train control
- Positive Train Control (PTC) technologies and their effect on in-cab human factors, including automated train control information requirements, display designs, real-time (and latent) and information flows, and the effect of operator experience on performance
- Applicability of integrated, multi-function, synthetic, moving map, and heads-up displays to the locomotive cab and the effect of these systems on human performance, including the identification of critical system design requirements
- Identifying the key information items and hierarchical criticality of information access for multi-function displays
- Impact of cab system technology on training and selection of train crew personnel- skill set and aptitude determination

Appendix D – Exhibits*

Standard Federal Acquisition Regulation (FAR) Clauses and Terms and Conditions

The separately attached EXHIBITS are supplied but are not all inclusive. The FAR and its supplements are amended periodically to reflect current Federal Statutes. The templates reflect current clauses required by regulation at date of BAA posting. Clauses may be added or removed based on the acquisition particulars. Exhibits are supplied as a planning tool for building good proposals and expediting future awards that may occur throughout the period of the BAA. The templates are based on business size or status:

EXHIBIT 1: LARGE BUSINESS STANDARD CLAUSES

EXHIBIT 2: SMALL BUSINESS STANDARD CLAUSES

EXHIBIT 3: UNIVERSITY STANDARD CLAUSES

EXHIBIT 4: TERMS AND CONDITIONS FOR GRANTS

****Will be added in a future amendment to the solicitation***