



U.S. Department
of Transportation

**Federal Railroad
Administration**

RESEARCH AND DEVELOPMENT STRATEGIC PLAN

FY2013–FY2017



OFFICE OF RESEARCH & DEVELOPMENT FRA OFFICE OF RAILROAD POLICY & DEVELOPMENT

RESEARCH AND DEVELOPMENT MISSION – Ensure the safe, efficient, and reliable movement of people and goods by rail through basic and applied research, and development of innovations and solutions.

RESEARCH AND DEVELOPMENT VISION – FRA's programs and activities are founded on the best science and technology, resulting in real world impact.

NOTICE

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective of this report.



U.S. Department
of Transportation

**Federal Railroad
Administration**

MAY 3 2013

Administrator

1200 New Jersey Avenue, SE
Washington, DC 20590

Dear Reader:

I am pleased to present the Federal Railroad Administration's Five-year Strategic Plan for Research and Development. This plan outlines our goals and strategies for ensuring FRA's programs and activities are founded on the best available science and technology, resulting in real world impact. It supports the Department of Transportation's strategic goals, the first of which is improving transportation safety.

A key theme in the plan is the engagement of railroad industry stakeholders in our research and development activities. Those same stakeholders have provided input to this plan either directly, through their own published plans or by commenting on early drafts. Important input has been received from the Association of American Railroads, the Transportation Research Board, and colleagues within the Department of Transportation including staff in the Research and Innovative Technology Administration.

I hope that reading this plan gives you an understanding of how our research and development program works and its priorities. I look forward to your engagement in what is a key program in the Federal Railroad Administration. We need the results from research and development to help us achieve our mission of enabling a safe, reliable and efficient movement of people and goods for a strong America, now and in the future.

Sincerely,

A handwritten signature in blue ink that reads "Karen J. Hedlund, for".

Joseph C. Szabo
Administrator

CONTENTS

1.	INTRODUCTION	2
1.2	Railroad Safety Trends	2
1.3	Industry Trends Affecting R&D	5
1.4	Legislative and Regulatory Trends	5
1.5	R&D Funding.....	6
2.	R&D PROGRAM GOALS.....	7
2.1	Safety	7
2.2	Other Priorities.....	7
3.	R&D STRATEGIES.....	9
3.1	Organizational Strategies.....	9
3.2	Facilities and Equipment Strategies.....	12
3.3	Stakeholder Engagement Strategies.....	13
3.4	Procurement Strategies	14
3.5	Partnership Strategies.....	15
3.6	Research Needs and Project Selection Strategies	16
4.	PROGRAM EVALUATION.....	18

EXECUTIVE SUMMARY

This plan describes the strategy through which the Federal Railroad Administration's (FRA's) research and development (R&D) program will support the Department of Transportation's (DOT's) mission and goals. Safety is the DOT's primary strategic goal and thus, the principal driver of FRA's R&D program. FRA's R&D program also contributes to other DOT strategic goals because safety-focused projects typically yield solutions that advance state of good repair, economic competitiveness, and environmental sustainability. The R&D program also has an important role to play in workforce development.

The significant railroad safety improvements achieved since the 1970s, coincident with increased traffic and axle loads, have been accomplished by addressing relatively easy-to-solve problems. Further improvements require research into the most significant remaining safety risks, such as trespassers, highway-rail grade crossing incidents, derailments and collisions. Addressing these hard-to-solve problems is a long-term process since new technologies and operating practices take time to discover, develop, test and implement widely. FRA's R&D program has contributed to railroad safety improvements over the last 20 years. Stable annual funding is necessary to sustain such contributions.

FRA's R&D program is founded on an understanding of safety risks in the industry. Hazard identification and risk analysis allow us to identify opportunities to reduce the likelihood of accidents and incidents, and to limit the consequences of hazardous events should they occur. Key, overarching strategies include:

- Prioritization of projects based on likelihood of real world impact
- Stakeholder engagement throughout project life cycles
- Partnerships with other researchers such as the Association of American Railroads
- Conducting research through cost-effective procurement

FRA's Transportation Technology Center (located in Pueblo, Colorado), laboratories and test trains are critical to the success of the R&D program. We will continue to practice prudent stewardship of these facilities and equipment, and encourage their shared usage with other industry researchers and Government agencies.

The success of the R&D program is measured by real world impact. This impact occurs when the end users implement the technologies and practices we develop, and the lessons learned from early adopters are shared across the industry. FRA has already begun the systematic evaluation of its research program. Over the period covered by this plan we will make evaluation integral throughout the R&D program lifecycle. Measurable outcomes will be identified that will continue to provide evidence of the achievement of our strategic goals.

1. INTRODUCTION

This Research and Development (R&D) Strategic Plan describes how the Federal Railroad Administration’s Office of Railroad Policy and Development will conduct its engineering and human factors research over the next 5 years. The strategy supports the U.S. Department of Transportation’s (DOT’s) strategic goals.¹

This Introduction sets the context for the plan by describing railway industry trends and examining historical funding levels for FRA’s R&D program. Section 2 ties FRA’s R&D program goals to the Department’s strategic goals. Section 3 gives details of strategies for defining R&D program areas, selecting projects, procuring research services, implementing research projects, and ensuring wide application of research results. The final section outlines plans for R&D program evaluations for monitoring the success of the program.

1.2 RAILROAD SAFETY TRENDS

In general, railroad safety has improved significantly since the 1970s, even while traffic and axle loads have increased. Table 1 shows accident and incident data reportable to the FRA for Fiscal Year (FY) 2011.² Fatalities are provided for Trespassers and Grade Crossing Incidents to provide context. They are not provided for the other causes since the year-to-year variation is significant (there were six fatalities across these other causes in FY 2011).

Table 1. Accident and Incident Data from FY 2011

	Fatalities	Accidents or Incidents	Accidents or Incidents/million train miles
Trespass	404	n/a	n/a
Grade Crossing Incidents	255	1973	2.754
Human Factors Accidents	**	685	0.956
Track-caused Accidents	**	669	0.934
Miscellaneous – excluding GC	**	299	0.417
Equipment-caused Accidents	**	238	0.332
Signal-caused Accidents	**	43	0.060

** - see text above

¹ U.S. DOT Strategic Plan FY 2010 – FY 2015, “Transportation for a New Generation”, April 15, 2010 – available at http://www.dot.gov/stratplan/dot_strategic_plan_10-15.pdf

² Requirements for reporting railroad accidents/incidents are found primarily in part 225 of title 49, Code of Federal Regulations.

Accidents involving trespassers are currently the number one cause of fatalities. Unfortunately, these numbers have remained stubbornly high for a prolonged period, as shown in Figure 1. Since trespassing on railroad property involves individual behavior, addressing this problem through R&D efforts will require a strong focus on human factors and preventative strategies.

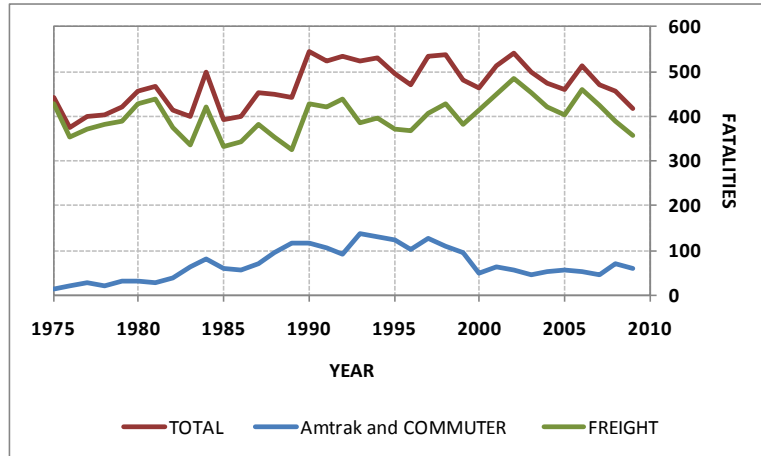


Figure 1. Trespasser Fatalities

Highway-rail grade crossing accidents, which in the 1970s killed nearly 1,200 people per year, are now the second largest cause of railroad-related fatalities—less than 400 per year since 2002. This number is comparable to trespasser fatalities, and thus needs to be addressed.

Human errors, such as locomotive engineers misreading signals, are the third largest cause of railroad accidents. Figure 2 shows the trends in accidents and fatalities related to human factors. The implementation of Positive Train Control on much of the U.S. rail network is expected to reduce the effect of human errors during train operation.

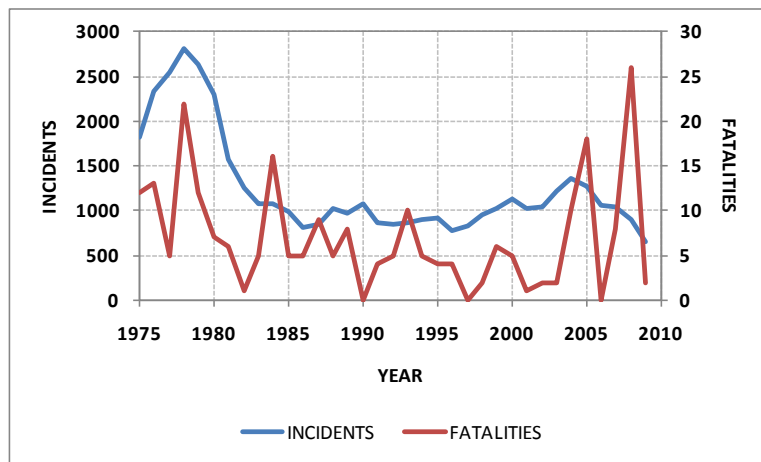


Figure 2. Human Factors-Caused Incidents and Fatalities

The fourth largest cause of accidents is track defects. Figure 3 shows the trend in track caused accidents and fatalities. The introduction of FRA's track safety standards in the late 1970s had a profound effect on reducing the number of incidents caused by track defects, as shown in Figure 3.

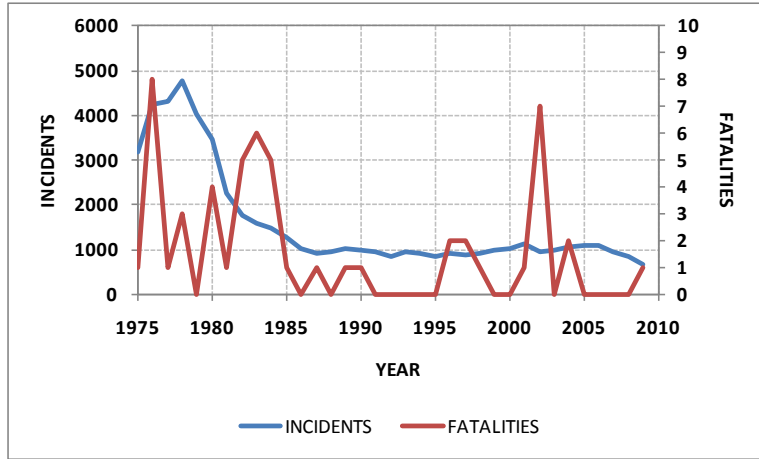


Figure 3. Track-Caused Incidents and Fatalities

The sixth largest cause of accidents (after miscellaneous causes) is rolling stock equipment defects. As Figure 4 shows, this trend is also improving and, since four deaths in 1994, no fatalities have occurred due to equipment defects.

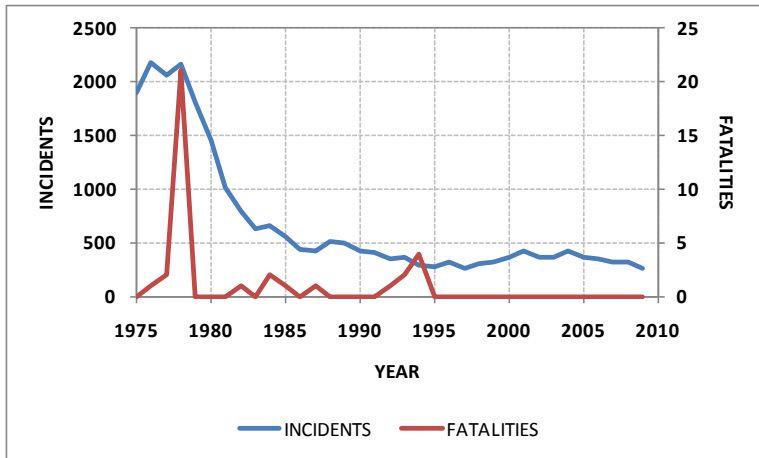


Figure 4. Equipment-Caused Incidents and Fatalities

Although signaling and train control defects have not caused any fatalities since 1996, the number of incidents has increased significantly. FRA is analyzing the reasons for the upward trend.

1.3 INDUSTRY TRENDS AFFECTING R&D

Passenger rail travel is significantly safer than highway travel, but as the number of passenger miles travelled grows we need to make rail travel even safer than it is today. Research, development and implementation of improved technology and operating practices is required to enable passenger trains to travel safely at high speeds. We need to learn as much as possible from overseas high-speed rail systems that have good safety records. Our processes for qualification of new equipment and components need to be valid and may require enhancement to our existing testing facilities.

Freight rail currently moves about 40 percent of the goods shipped nationwide (as measured in ton-miles), and DOT expects the demand for freight rail service to increase 22 percent from 2010 levels by 2035.³ Continued R&D into conventional freight operations is necessary to ensure that this growth does not adversely affect safety.

There are many technological and safety issues to be addressed when passenger train speeds and frequencies increase on corridors shared with freight. These issues need to be catalogued and prioritized. Research needs will then be identified for the high priority issues. The research is likely to be a combination of computer modeling and experiment. Some in-service testing is also anticipated.

Lack of investment in passenger rail has resulted in a shrinking pool of domestic experts in the field, including personnel skilled in signaling, track and rolling stock design, and planners and managers. The domestic manufacturing industry has also declined.

1.4 LEGISLATIVE AND REGULATORY TRENDS

The Rail Safety Improvement Act of 2008 laid the foundation for a number of initiatives including the Risk Reduction Program and implementation of Positive Train Control on some rail corridors. Addressing safety risk is a different approach to traditional safety oversight. It requires the close involvement of the industry in identifying safety hazards, analyzing risk and establishing control measures. This is part of a general shift from prescriptive standards towards Safety Management Systems (SMS) and performance-based regulations that emphasize the management and control of risk. Railroads are being encouraged to develop safety management systems that explain to FRA how risk will be managed and an adequate level of safety will be assured.

New locomotive emissions standards come into effect in 2015 (Tier 4). The challenging new standards require remanufactured and newly designed locomotives to have significantly lower particulate matter (PM) and oxides of nitrogen (NOx) emissions.

³ “National Rail Plan – Moving Forward, A Progress Report” U.S. DOT, Federal Railroad Administration, September 2010 – available at http://www.fra.dot.gov/downloads/NRP_Sept2010_WEB.pdf

1.5 R&D FUNDING

Appropriations for FRA R&D have been generally constant since 2006 at around \$35M per year when adjusted by the consumer price index (Figure 5).⁴ In addition, as appropriations become available, FRA has funded research into high-speed and intercity passenger rail. Stable funding enhances the effectiveness and viability of FRA's R&D, enabling multiyear projects, investments in test facilities and equipment, and building and retaining expertise. Universities can develop educational programs to ensure a supply of qualified engineers is available to the industry. Partnerships can be established with industry stakeholders. This sustained funding allows a core of expertise to thrive. Knowledge is retained and can be drawn on when accidents need to be investigated or other urgent needs arise.

While current funding levels allow us to meet the most pressing needs for safety related R&D, there are opportunities to expand university R&D programs that would give benefits in both new technologies and workforce development. Efforts associated with energy, the environment and railroad transportation efficiency could also be expanded beyond that currently possible under the core R&D funding.

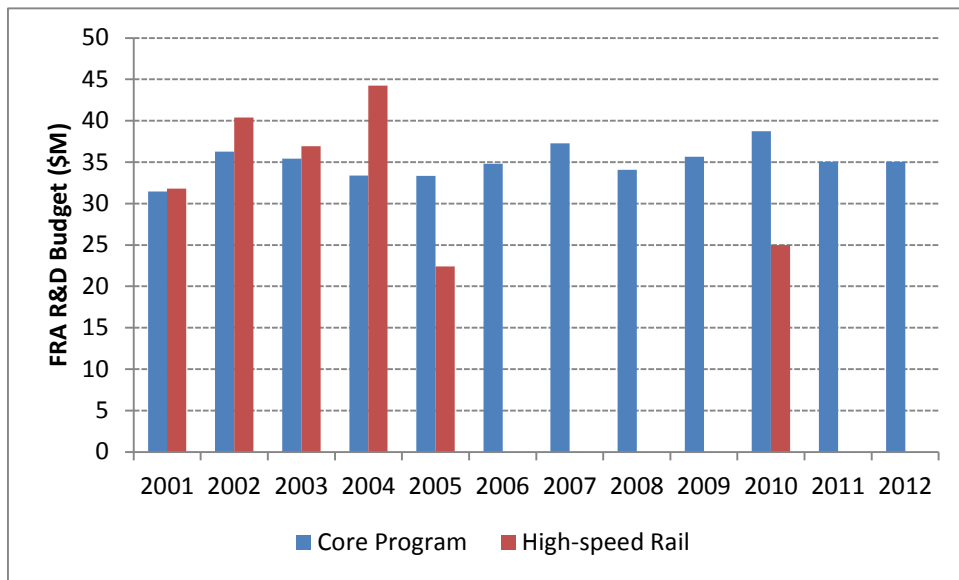


Figure 5. FRA's R&D Appropriations (Consumer Price Index adjusted)

⁴ Excluding occasional special projects, such as Maglev and the National High-Accuracy Global Positioning System.

2. R&D PROGRAM GOALS

Our mission is to ensure the safe, efficient and reliable movement of people and goods by rail through basic, applied and developmental research.⁵ We will do this by providing the best available scientific and technical foundation for FRA's railroad development and regulatory activities.

2.1 SAFETY

Safety is the DOT's primary strategic goal and thus, the principal goal for FRA's R&D program. The R&D goal is to reduce safety risk by reducing both the likelihood of accidents occurring and the consequence should they occur. Consequence can be defined as the harm to which an individual or group of people is exposed, and, in this sense, is the weighted summation of fatalities, injuries, shock and trauma. Reducing risk over time will reduce the number of accidents and actual harm.

We are creating a safety risk model that will be forward-looking, enabling us to take a proactive approach to improving safety. The model will identify the total harm for our area of concern and how harm is divided into various categories. While the model will be based on historical accident data—FRA's Railroad Accident/Incident Reporting and Highway-Rail Accident/Incident databases— it will also incorporate findings from FRA inspections, accountable accidents (those that fall below the FRA reporting dollar threshold), and close call reports. The model will also reflect recent changes in regulations, technology, and operating conditions.

Periodically, FRA, with a cross-industry panel of experts, will revise the safety risk model to reflect the most recent accident data, new technology, operating practices and regulations.

2.2 OTHER PRIORITIES

While being driven by the safety goal, we seek projects that also contribute towards the other DOT strategic goals.

2.2.1 State of Good Repair and Economic Competitiveness

Improving the detection of defects in rails is an example of an R&D project that is driven by safety and has additional benefits towards other goals. The main objective is to reduce the risk of train derailments from broken rails, thereby improving safety. In addition, the technology provides information to the railroads to help them keep the rail asset in a state of good repair. By reducing train delays from broken rails in service, it also helps the railroads maintain their economic competitiveness.

⁵ Basic research – building knowledge, understanding and capability without specific applications towards processes or products in mind; Applied research – applying the products of basic research towards determining the means by which recognized and specific needs may be met; Development – the production of useful materials, devices and systems or methods, including the design, production and evaluation of prototypes and new processes to meet specific requirements. Adapted from Office of Management and Budget Circular No. A-11, Preparation, Submission and Execution of the Budget, August 2011.

2.2.2 Environmental Sustainability

FRA's R&D program will include an Energy, Environment and Engine (E3) subprogram to focus on the DOT's environmental sustainability goal.

One of the goals of our rail E3 research subprogram is to support the efforts of the industry in meeting the new EPA emissions standards.

Another goal is to become less dependent on fossil fuels by promoting the acceptance and increased usage of alternative fuels and technologies by the railroad industry.

2.2.3 Livable Communities

Investment in high-speed and intercity passenger rail will contribute to achieving the DOT's livable communities goal. Our goal is to work with the Next Generation Equipment Committee⁶ to ensure new passenger rail cars are safe, efficient and accessible to people with disabilities.

2.2.4 Workforce Development

FRA's R&D program has a contribution to make to workforce development in the railroad industry. The funding we provide to universities to undertake research enables those universities to provide opportunities for postgraduates and, in some cases, to hold railway engineering classes. Our goal is to increase the number of students who have had opportunities to learn about railroads while at university and go on to have successful careers in the railroad industry.

⁶ The Next Generation Equipment Committee was formed under Section 305 of the Passenger Rail Investment and Improvement Act, 2008.

3. R&D STRATEGIES

3.1 ORGANIZATIONAL STRATEGIES

One of the critical success factors of previous FRA R&D achievements is the organization of the office into four divisions and ten program areas. Table 2 shows how divisions and program areas relate to the most frequent causes of accidents and incidents.

Table 2. R&D Program Areas and Accident and Incident Causes

R&D Division and Program Area	Accident or Incident Cause				
	Trespass	Grade Crossing	Derailment	Train Collision	All Other Causes
Office of R&D					
Railroad Systems Issues					X
Human Factors Division					
Human Factors Research	X	X	X	X	X
Track Division					
Track and Structures			X		X
Track and Train Interaction			X		
Facilities and Equipment	X	X	X	X	X
Rolling Stock Division					
Rolling Stock and Components			X	X	
Hazardous Materials			X		X
Train Occupant Protection		X	X	X	X
Train Control and Communications Division					
Train Control and Communications			X	X	X
Grade Crossings and Trespass	X	X			

Projects will continue to be executed by program managers reporting to Division Chiefs. This structure allows professional development of engineers and scientists in their particular disciplines. The new focus on key safety hazards will encourage staff in different divisions working on common risks to collaborate and adopt systems-based approaches to achieving goals.

3.1.1 Railroad Systems Issues

This program area will direct the entire R&D program towards the DOT's goals and provide assurance that those goals are being met. Near-term strategic priorities are:

- Develop and use a safety risk model to help identify R&D priorities
- Build FRA capabilities for program evaluation to ensure projects have the highest probability of delivering benefits
- Continue to fund projects to address the DOT's environmental sustainability goal
- Seek opportunities for university funding to develop the future railroad workforce

3.1.2 Human Factors Division

Human errors now account for more than one third of all train accidents in the U.S. railroad industry. Railroads depend on the adaptability of people, as well as the performance of infrastructure, equipment, and control systems to keep the system safe. Railroad workers need knowledge, training, tools and alertness to do their jobs properly and to ensure the public, their coworkers' and their own safety. 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. Strategic priorities for the human factors division include:

- Conduct pilot trials to improve safety and organizational culture in railroad organizations
- Conduct research on fatigue, distraction and ergonomics to address individual and team behavior
- Develop technology, automation and systems design to minimize the potential for human errors

3.1.3 Track Division

Track and infrastructure failure is the second leading cause of train derailments in the U.S. Incorrect interaction between moving vehicles and the track is a common cause of derailments. Strategic priorities for this division are:

- Develop track inspection technologies that detect defects before they become failures in service
- Develop computer modeling capabilities to improve understanding of vehicle-track interaction, wheel and rail profiles and contact conditions
- Expand the use of autonomous recording methods to provide more frequent and cost-effective measurements of track condition
- Develop new methods for monitoring difficult to detect safety issues such as longitudinal rail force, ballast lateral restraint and ballast condition

3.1.4 Rolling Stock Division

R&D in this division aims to reduce the likelihood of derailments from equipment failures and to mitigate the consequences should derailments occur through these or other causes. Strategic priorities are:

- Investigate the effectiveness of wayside and on-board monitoring systems to detect equipment defects
- Analyze component failure modes to identify necessary improvements in materials and construction methods
- Prioritize R&D projects to reduce the risk of transporting hazardous materials by rail
- Build on the recent progress in revising regulations for crashworthiness of rail vehicles to further improve safety in collisions and derailments
- Prioritize R&D projects to improve fire safety for passenger cars and for fuel tanks on both conventional locomotives and diesel multiple unit trains

3.1.5 Train Control and Communications Division

Train control and communications R&D is aimed at eliminating train-to-train collisions, avoiding over-speed derailments and increasing the safety of track workers. Strategic priorities are:

- Support the railroads in meeting the deadlines for implementation of Positive Train Control (PTC)
- Continue to support the Generalized Train Movement Simulator to help the industry implement PTC optimally
- Identifying areas of residual risk after PTC implementation to determine future R&D needs

This division also addresses the top two causes of railroad fatalities and injuries: collisions at highway-rail grade crossings and trespassers hit by trains. The strategic priorities are:

- Advance safety technologies, education and community outreach to improve grade crossing and trespass safety through local pilot trials, and then publicize successes
- Explore opportunities offered by Intelligent Transportation Systems (ITS) to improve grade crossing and trespass safety
- Hold research needs workshops on highway-rail grade crossing safety and trespass prevention to identify further opportunities for research-driven improvements to safety

3.2 FACILITIES AND EQUIPMENT STRATEGIES

3.2.1 Transportation Technology Center

The FRA owned Transportation Technology Center (TTC) in Pueblo, Colorado has a strategic role in the R&D program. Since its dedication as the High Speed Ground Test Center in 1971, it has played an important part in research, development and testing of rail infrastructure and equipment. Amtrak's Acela train, for example, was tested at TTC prior to commencement of revenue service in 2000. The facility will continue to be used to ensure the safe implementation of new rolling stock and infrastructure technology.

TTC is managed under a unique Care, Custody, and Control contract. The contractor is allowed to use the facility for its own purposes, but in return it must maintain the facility and invest in site improvements. Annual maintenance and improvement plans will continue to be agreed with the FRA and reconciled with the Site Master Plan.

Environmental sustainability improvements will continue to be made towards the DOT's targets for high-performance buildings and renewable energy.

In recent years the Transportation Security Administration (TSA) has created the Surface Technology Security Training Center located at TTC, providing training to Department of Homeland Security inspectors and other federal, state and local security partners. This is one of several cases of other Federal agencies using TTC. FRA encourages other government agencies to use the facility on the condition that such usage does not interfere with FRA's core requirements. We will normally require a Memorandum of Agreement to clarify requirements and an Inter-Agency Agreement if funds and authority are to be transferred to FRA.

3.2.2 Cab Technology Integration Laboratory

FRA's Cab Technology Integration Laboratory (CTIL) is used for human factors research. It is a complete locomotive cab with windows replaced by computer monitors that display images of passing track and scenery. CTIL is housed at the Volpe Center in Cambridge, Massachusetts. In addition to conducting FRA's research, we will make CTIL available to the industry and other researchers.

3.2.3 Test Cars and other Government Furnished Equipment

FRA owns two research rail cars, a road-rail vehicle, instrumented wheelsets and various portable devices for inspection and measurement. This equipment is managed for FRA under an Operation, Maintenance, Instrumentation and Analysis (OMIA) contract. The contractor is responsible for maintenance and storage of the equipment.

This equipment will continue to be used for:

- Independent evaluation by the FRA of railroads' track and structure integrity through quick-response instrumentation, test support and materials testing.
- Providing a platform for the testing and development of new inspection technologies in the harsh railroad environment

3.3 STAKEHOLDER ENGAGEMENT STRATEGIES

We believe that genuine stakeholder engagement is the cornerstone for building a successful R&D program. Engagement throughout the lifecycle of a research project is crucial for identifying, prioritizing, and implementing research that is both relevant and feasible to intended users. This strategy helps ensure that we have systematic input and multiple perspectives to build the most relevant and useful research program possible. It substantially increases the likelihood that the products of our research will be used and will have wide-scale impacts.

A key internal stakeholder of FRA's R&D program is the Office of Railroad Safety. R&D provides the scientific and technological basis for rulemaking and rule enforcement. The Railroad Safety Advisory Committee (RSAC) structure provides an important forum for presenting and discussing research results that are being used in rulemaking. A recent example is the results of modeling and full-scale testing that were used to guide changes to crashworthiness requirements for passenger rail cars.

FRA's Office of Passenger and Freight, which manages grants and loans for railroad investment and development, is another important internal stakeholder. The Office of Research and Development provides technical guidance on investments. For example, R&D staff lead several industry task forces of the Next Generation Equipment Committee involved in writing specifications for new passenger rolling stock that will be funded by FRA.

External stakeholders include the passenger and freight railroads because they are responsible for implementing the R&D outputs—technologies, practices and policies. Our strategy is to involve the railroads at an early stage in the R&D process and to keep them informed of progress. Through the Association of American Railroads, we will continue to be engaged in the industry's technical committees that conduct research and develop standards and recommended practices.

Our stakeholder strategies include active engagement with our labor and manufacturing partners, soliciting their input and feedback as participants in oversight committees, working groups, and informal meetings and feedback.

Together with the Office of Railroad Safety, we will continue to collaborate with the American Passenger Transportation Association (APTA) in developing and maintaining standards and recommended practices for passenger rail rolling stock.

Industry outreach will also include interaction with the American Railway Engineering and Maintenance-of-Way Association (AREMA), the Railway Supply Industry, the Transportation Research Board (TRB), the American Society of Mechanical Engineers (ASME), and the Institute of Electrical and Electronic Engineers (IEEE), among others.

Another part of our outreach strategy is to hold periodic R&D reviews in Washington DC. The events are free and open to the public. They typically take place over 2 days and include presentations on progress from all R&D project managers. Attendees are

provided with a current list of R&D projects that includes contact details for further questions and involvement.

3.4 PROCUREMENT STRATEGIES

Most of the R&D work sponsored by the FRA is conducted by contractors and grantees. Research providers include research institutions, universities and consulting firms. Consistent funding levels over several years have allowed FRA to build a strong R&D supply base, which is critical to the success of the program.

In accordance with the Federal Acquisition Regulations, whenever practicable, every attempt will be made to enter into contracts for research work competitively awarded on a best-value basis. Contracts may be negotiated on either a firm-fixed-price or cost-reimbursable basis. Research contract opportunities will be advertised on the Federal Government's acquisition website: www.fedbizopps.gov.

Additionally, research projects may be funded by FRA through grants and cooperative agreements, primarily with non-profit institutions and universities. A grant agreement is appropriate when the grantee is solely responsible for conducting the project. A cooperative agreement is appropriate when both the grantee and the government or a third party participate in the project effort.

Work will continue to be funded through interagency agreements between FRA and a sister agency within DOT, the John A. Volpe National Transportation Systems Center (Volpe) in Cambridge, MA. Volpe has developed expertise in several technical areas through collaboration with FRA over many years. That expertise is key to the success of FRA's R&D mission.

Part of FRA's procurement strategy is to enter in to multiyear contracts for particular services. An example is the long term contract with Transportation Technology Center, Inc. (TTCI), which manages and operates the federally owned Transportation Technology Center. In addition to covering the management of the facility, the contract allows FRA to place task orders with TTCI for a variety of R&D services.

Another long-term contract is with ENSCO, Inc. for the Operation, Maintenance, Instrumentation and Analysis (OMIA) of R&D's test cars and road-rail vehicle. This 5-year contract also allows for task orders to be placed for general R&D support services.

The third area of long-term contracts is a group of multiple, concurrent awards to several suppliers that allow FRA to draw upon contractors' particular expertise for research services on short notice. These Indefinite Delivery - Indefinite Quantity (IDIQ) contracts typically run for 5 years.

The Small Business Innovation Development Act of 1982 requires a small, but increasing, portion of governmental research budgets to go towards Small Business Innovative Research (SBIR) projects. The FRA has had some successful outcomes from SBIR projects. We will continue to fund the SBIR program at the required level and seek projects that are aligned with our strategic goals.

The Transportation Research Board (TRB) of the National Academies of Science manages two research programs using FRA's R&D funds:

- **Innovations Deserving Exploratory Analysis (IDEA) Program**, which seeks technology not necessarily developed for the railroads but that might have a railroad application.
- **National Cooperative Rail Research Program**, which invites the industry to submit ideas for research. It was introduced in 2010 and initially focuses on policy, rather than technology, research.

Both the SBIR and IDEA programs have a two stage funding approach. Work begins with modestly funded Phase I efforts. Projects that show promise may receive Phase II funding that may result in a prototype or proof of concept. We will continue with these programs subject to the availability of funds.

Periodically, the FRA provides funds for research through a Broad Agency Announcement (BAA). The two most recent examples are the Positive Train Control BAA of 2009 and the High-speed and Intercity Passenger Rail BAA of 2010. A BAA allows FRA to publicize a set of general research needs and to receive proposals from potential suppliers. Each proposal is evaluated independently to determine its fit with the needs and its value. We will continue to use the BAA approach as part of our procurement strategy.

3.5 PARTNERSHIP STRATEGIES

The Association of American Railroads (AAR) conducts research on behalf of all the major freight railroads in the U.S. and Canada. By participating in the AAR technical committees, we will look for opportunities to co-fund projects and avoid duplication of research efforts. The AAR's recently updated technology roadmap⁷ will be used to help identify such opportunities. The railroad industry often comes up with technology that will improve efficiency or extend the life of an asset. FRA has recently developed a process for ensuring any such technology provides an acceptable level of safety. When requested, we will help guide industry partners through this safety assurance process.

FRA will continue to conduct R&D in close collaboration with the Research and Innovative Technologies Administration (RITA). We worked closely with RITA to draft DOT's latest research, development and technology strategic plan, which has been a key driver in forming this FRA R&D plan.

RITA is developing an on-line database of research projects⁸ to improve access for interested parties. It is also working with the Transportation Research Board to improve the availability of research reports on-line. We will continue to support these initiatives.

⁷ "Railroad Industry Priority Technical Goals and Directions for the Next 20 Years", Association of American Railroads, November 2011

⁸ U.S. DOT Research Hub – available at <http://ntlsearch.bts.gov/researchhub/index.do>

We plan to share research results with the Federal Transit Administration (FTA). We will agree with FTA how our research facilities and equipment can be shared. We anticipate co-funding of R&D projects that are of mutual interest.

In addition to technical collaboration with other modes, we will work through RITA to improve our research methods. We will share best practice in program evaluation, budget formulation, risk analysis and technology transfer. This is one way we will work towards the DOT's goal for organizational excellence.

3.6 RESEARCH NEEDS AND PROJECT SELECTION STRATEGIES

R&D projects have historically arisen from numerous internal and external sources. We will continue to seek projects that address DOT's goals from FRA's Office of Railroad Safety, the rail industry, academia, and industry suppliers.

The safety risk model will be key to identifying research needs. In consultation with the Office of Railroad Safety, we will also identify project concepts that address the mission-critical needs of FRA inspectors.

Together with the AAR, we will continue to scan universities for technological developments that may have railroad application. We will also collaborate with the international rail research community to share research results and to seek opportunities to co-fund research projects.

Additional sources of research needs will include governmental policy directives, regulatory committees such as the Railroad Safety Advisory Committee (RSAC), and other government organizations such as the National Transportation Safety Board (NTSB) and the American Association of State Highway and Transportation Officials (AASHTO).

The activities described above result in more R&D projects being identified than can be typically funded. We will continue to use a project selection process to ensure the highest priority projects are funded. High priority projects will satisfy at least one of the following criteria:

- Directly focuses on reducing rail-road related fatalities and injuries
- Develops information required for pending or planned rulemaking or Railroad Safety Advisory Committee review
- Directly influences industry standards or best practices
- Directly addresses an outstanding NTSB recommendation to FRA or one of NTSB's "most wanted" rail safety improvements
- Improves efficiency or effectiveness of field inspection forces
- Has benefits towards DOT goals in addition to improving safety
- Stakeholders generally believe that the project as conceived will be successful and will accept or implement the outcome
- Outcome will yield safety benefits in excess of cost to implement

- Represents novel research for the purpose of developing fundamental knowledge
- Is close to implementation

Project scores, based on the above criteria, will be calculated first by project managers. Then they will be reviewed by Division Chiefs and finally, by the Office Director. The highest scoring projects will be included in the annual acquisition plan, and then approved by the Associate Administrator for Railroad Policy and Development and by the Federal Railroad Administrator.

Projects mandated by Congress will be funded without being analyzed through the project selection process.

4. PROGRAM EVALUATION

The value and success of our R&D has three key indicators: high quality publications, feedback from external evaluations conducted by the Transportation Research Board, and, most importantly, real world impacts.

We publish two types of reports on our website:

- Research Result Summaries – four-page reports that describe significant R&D projects milestones or outcomes
- Research Reports – complete records of research projects providing details of methodology and results

In addition, many projects produce peer reviewed papers documenting interim and final project results of general interest. Our research reports and papers are also available through RITA’s Research Hub and the Transportation Research Board’s publication database.⁹

Since 1996, the Transportation Research Board (TRB) of the National Academies of Science has annually reviewed the FRA R&D program. TRB’s appointed expert panel receives presentations from FRA staff, and then summarizes its findings in a letter report to FRA. Representatives from the largest railroads, academia, States, and former, senior government staff typically comprise the expert panel. The letter report includes recommendations on the future direction of the R&D program and makes suggestions on priorities when funding is limited.¹⁰ We will continue to consider TRB inputs in setting R&D priorities and planning projects.

Real world impacts occur when railroads, manufacturers, and others implement the technologies and practices we develop. FRA R&D drives early stage technology and process development, and then transfers ownership to the end user.

The Government Performance and Results Act (GPRA) directs agencies to assess the manner and extent to which their programs achieve intended objectives. The Office of Management and Budget has launched government-wide efforts to strengthen program evaluation.¹¹ In the period covered by this strategic plan, FRA will make evaluation integral to the R&D program lifecycles by building evaluation methods into each project from the start. Conducting state-of-the-art program evaluations in all of our R&D program areas will help us achieve our mission of improving the safe, efficient, and reliable movement of people and goods in the U.S. railroad industry.

Beyond assessing and reporting on goal achievement, we will systematically assess safety risks and needs in the railroad industry, rigorously evaluate R&D priorities and plans,

⁹ <http://trid.trb.org/>

¹⁰ The most recent report is available at http://onlinepubs.trb.org/onlinepubs/reports/frar&d_May_2012.pdf

¹¹ “Increased Emphasis on Program Evaluations”, Office of Management and Budget, October 7, 2009

systematically monitor and document project implementation, assess the full range of intended outcomes and positive or negative unintended outcomes, and promote use of R&D results. By building logic models for R&D projects, we will identify outputs that can be readily measured and monitored as precursors to incidents, injuries, and fatalities.

Our plan for institutionalizing evaluation and building our evaluation capacity has the following goals:

- Scope – Develop and integrate quality evaluation standards that span the entire R&D life cycle, including program planning, development, implementation and technology transfer. Ensure evaluations conducted are highly credible, accurate, relevant, timely, useful and meaningful to their intended range of industry stakeholders, including Congress and the public.
- Procedures – Develop and implement written guidelines for incorporating evaluative language into contracts and grants, and written guidelines for measuring the usefulness and effectiveness of R&D projects and programs from beginning to end.
- Workforce development – Develop evaluation knowledge, skills and competence within R&D staff to institutionalize evaluation practices as a tool for improving the utilization, impact and effectiveness of R&D.
- Staffing and budgeting – Secure long-term staffing and budgeting that can make evaluation planning and budgeting a regular part of R&D program planning.
- Transparency and accountability – Ensure evaluation findings related to public accountability are disseminated to policy makers, senior leaders and other key decision makers to appropriately inform policy and decision making.

Achieving these goals is expected to result in R&D projects that are increasingly successful and accountable, plus enhanced credibility for the Office of R&D.