



April 22, 2009

The Honorable Karen Rae  
Deputy Administrator  
Federal Railroad Administration  
1200 New Jersey Avenue, S.E.  
Washington, DC 20590

Dear Ms. Rae:

The Transportation Research Board's (TRB's) Committee for Review of the Federal Railroad Administration (FRA) Research and Development (R&D) Program held its third meeting on November 13–14, 2008, and its fourth meeting on March 12–13, 2009; both meetings were held in Washington, D.C. Attending committee members are listed in Enclosure 1, and participating FRA and Volpe staff and other guests are listed in Enclosure 2.

This committee is charged with conducting an annual review and evaluation of FRA's R&D program covering such topics as program management structure and approach, allocation of resources among program areas, outreach to the program's customers and stakeholders, project selection criteria, and project management. The committee is also asked to review the major research directions of the program, as well as the content of the research program areas, for applicability to the needs of the program's customers and stakeholders both within and external to FRA.

The committee thanks those who participated in and contributed to its November and March meetings, including Jo Strang, Mark Yachmetz, Magdy El-Sibaie, Gary Carr, Sam Alibrahim, other members of the FRA R&D staff, and Volpe/Research and Innovative Technology Administration (RITA) staff. Without the full cooperation of FRA management and staff, the committee would be unable to fulfill its charge.

The world has fundamentally changed for FRA in recent months. At the March meeting, the committee clearly saw the beginnings of impacts of the enactment and subsequent implementation of the Rail Safety Improvement

Act of 2008 (RSIA) and the Passenger Rail Investment and Improvement Act of 2008 (PRIIA),<sup>1</sup> the change of administration in January, and the enactment of the American Recovery and Reinvestment Act (ARRA) in February. As will be discussed in more detail below, each of these pieces of legislation has significant impacts on FRA's programs and R&D: RSIA requires implementation of positive train control (PTC) by 2015; PRIIA creates three new programs to assist development of intercity and high-speed passenger rail; and ARRA provides \$8 billion to fund projects under those three new programs. This broad new range of program responsibilities and opportunities given to FRA in turn have implications for R&D activities. A rapid response may be difficult given existing budget constraints. Even so, FRA should make every effort to avoid delay in responding effectively to changing R&D requirements and focus areas.

The timelines laid out in ARRA are tight and demand fast action by FRA. In many cases complementary resources have not yet been provided. For example, before the issuance of this report, FRA will have been required to submit a strategic plan to Congress explaining how \$8 billion provided in ARRA will be used to improve and deploy high-speed and intercity rail passenger systems. Development of guidelines for review of rail passenger grant applications due in June will also be well under way.

Overall, the committee believes that FRA is responding quickly and responsibly and is demonstrating flexibility in facing significant challenges. The challenges can be summarized as the need to manage the intersection of freight and passenger rail interests strategically while balancing safety, policy, and R&D issues. The results of R&D projects will be critical to the successful implementation of new technologies for large-scale investments in PTC and high-speed rail. R&D faces challenges in hiring needed staff in engineering and transportation disciplines and obtaining additional funding to set about the new tasks resulting from the administration's focus on these areas. While authorized funding levels for rail activities in the new legislation are unprecedented, FRA faces practical difficulties in obtaining administrative funds and full-time equivalent positions for proper staffing to carry out its high-priority mandates. This is a marked change from past limitations, which resulted entirely from the budget process, and FRA realizes it has tremendous opportunities and responsibilities.

At the November meeting, FRA and Volpe staff provided a status report on a project selection and rating process. In view of the new tasks facing R&D, it is important that the projects undertaken and their outcomes be suitably evaluated. The committee urges continued development of the process and

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<sup>1</sup> P.L. 110-432, enacted on October 16, 2008, includes both RSIA and PRIIA.

application of review results to development of a new 5-year strategic R&D plan. Highly rated projects should be identified to help guide development of the plan.

In support of FRA's efforts through this transition period, the committee offers the following recommendations:

**Recommendation 1.** (a) The Office of R&D should focus on the role of R&D initiatives and results in large-scale programs, such as PTC and high-speed rail. R&D can provide technological advances in these program areas rather than having to rely on regulatory actions alone. (b) The office should seek more funds for R&D, potentially from the many new programs that have been created. FRA officials have latitude in some programs to devote a portion of funds to research.<sup>2</sup> (c) The office should revise the 5-year R&D strategic plan to focus on new opportunities. As far as the committee knows, this was last done in 2006, and there is now a compelling, strategic need to manage the intersection of freight and passenger rail interests while balancing safety, policy, and R&D issues. If safety is the only R&D goal that FRA pursues, it will risk setting back progress in the deployment of new technologies related to high-speed rail, PTC, and other complex areas. Development, testing, and implementation of PTC, for example, are critical in permitting mixed freight and passenger traffic on the same lines. Finding a balance between safety and the timing of deployment depends on applying risk management and performance measurement skills and techniques.

These recommendations are intended to assist FRA R&D in making the case for its Fiscal Year 2011 and future budget requests.

## **REVIEW OF RESEARCH PRIORITIES FROM 2006 WORKSHOP PROCEEDINGS**

FRA provided an overview of the research priorities that the committee has endorsed since the TRB rail research needs workshop in 2006.<sup>3</sup> In light of

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<sup>2</sup> For example, in RSIA, Sec. 103, the Railroad Safety Risk Reduction Program, provides the Secretary with discretion in conducting certain types of research before promulgating regulations. In PRIIA, Sec. 306, the Rail Cooperative Research Program, authorizes the creation of and appropriations for such a program for 4 years.

<sup>3</sup> The workshop report, *Conference Proceedings on the Web 3: Research to Enhance Rail Network Performance*, is available at <http://onlinepubs.trb.org/onlinepubs/conf/CPW3.pdf>.

the recent changes, a review of these priorities is timely (several will be addressed in more detail below):

1. *PTC and related technologies:* The committee's highest priority remains at the top of the list of recommendations to FRA, since RSIA requires implementation by 2015. To meet the RSIA timetable, R&D efforts continue on several key elements, while other elements remain under development by the rail industry and suppliers. (See section on PTC below.)
2. *Performance-based standards and risk-based analysis:* The committee is pleased to see that FRA is adapting to the new circumstances—for example, by establishing performance-based regulations for PTC. More risk analysis, including consideration of risk mitigation strategies, is also being undertaken for poison- or toxic-by-inhalation hazardous materials (PIH or TIH) handling, tank car designs, and new passenger car designs.
3. *Highway–rail intersection safety:* With the new emphasis in ARRA on high-speed passenger rail development, it is important that grade-crossing technology development be tied to high-speed rail corridor development.
4. *Human resource management:* Developments in such areas as PTC, sensors, information technology, command, control, and communications, and high-speed rail have brought about a need for improvements in applying human factors analysis and related designs to cost-effective solutions. With respect to PTC in particular, there is a need for human–systems integration (HSI) analyses that go beyond the performance of the individual system components, such as cab display technology, to examine the implications for operations and maintenance procedures.
5. *Network capacity analysis:* FRA is planning an initiative for forecasting freight and adding more passenger traffic to the system. Capacity is sufficient for freight in the short term, especially given the current recession. However, the committee is concerned about the consequences of adding high-speed and intercity passenger rail into a freight rail system optimized for heavy axle loadings (HAL) in response to new imperatives. Of particular concern with regard to mixed passenger and freight operations is reliance on PTC technology that is added as an overlay rather than developed along with high-speed rail on separate rights-of-way. Big changes in the rail freight traffic mix are coming, and they must be taken into account in planning passenger system upgrades.
6. *Energy efficiency and environmental issues:* These are timely topics in light of the new administration's priorities. FRA has funded a few

energy efficiency projects with useful results and indicated to the committee that the Fiscal Year 2011 budget request will include additional funds in this area.

In the context of legislative requirements, the National Rail Plan called for in PRIIA, and economic recovery goals and related timelines, research priorities have changed and need to be reviewed.

## **PRIORITY RESEARCH AREAS**

### **Positive Train Control**

After two decades of research, development, and demonstration work by the industry, FRA, and suppliers, and after deployment of ACSES,<sup>4</sup> ETMS,<sup>5</sup> and other communications-based train management or control systems on limited corridors, implementation of PTC has been made mandatory by RSIA. Implementation is required by 2015 for specific categories of freight, commuter, and intercity passenger lines defined in the act. Moreover, the Southern California Regional Rail Authority has declared its intention to deploy PTC on Metrolink lines by 2012. Meeting these requirements will depend on actions by FRA's Office of Safety and Office of R&D, as well as by a number of industry groups and committees. In preparation for the March meeting, the committee asked FRA to clarify the respective roles of all these entities, and in particular to identify research that must be completed to support PTC implementation. The committee thanks Olga Cataldi of the Office of Safety for reporting on the status of regulatory developments under RSIA to support PTC implementation.

To meet the statutory requirements, FRA will have issued draft regulations for PTC implementation by April 16, 2009. The committee was not privy to the content of the regulations as it developed its report, but it is encouraged by FRA's flexible approach in developing the regulations. For example, the proposed regulations will allow for an optional product-type approval process based on risk analysis and mitigation strategies under which approval for a system developed by one railroad will be applicable to any railroad or vendor. (An installation certificate will still be required for each one.) The railroads must submit their PTC implementation plans by April 16, 2010, for FRA approval.

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<sup>4</sup> ACSES is the Advanced Civil Speed Enforcement System, which is generally referred to by the acronym.

<sup>5</sup> ETMS is the Electronic Train Management System, which is generally referred to by the acronym.

The Office of R&D now has broad responsibility for (a) advancing particular train control technologies required for PTC implementation and (b) supporting the Office of Safety in the rulemaking activities. R&D will assist Safety and the railroads in solving unforeseen technical issues that arise during the implementation phase. It appears prescient that earlier in 2008, before RSIA was enacted, FRA not only established the Signal, Train Control, and Communications Division within the R&D Office but also hired a qualified division chief to ensure a focused effort on PTC.

On the basis of FRA's presentations and discussion, the committee believes that the most critical and challenging elements in ensuring PTC implementation are the following, in which R&D is actively involved:

- Interoperability of key PTC systems components (for example, between versions of ACSES and ETMS);
- Adaptive braking algorithm;
- Radio frequency spectrum and throughput;
- Precision location systems;
- Data security issues, standards, and integrity;
- Communications protocol testing;
- Validation and verification of safety-critical system designs;
- Employee-in-charge portable terminal for management of work zone safety;
- Cost-effective deployment of "smart" switch position indicators; and
- HSI.

The committee has the following concerns and questions about the ramp-up to PTC implementation that were not fully explored with FRA management and staff during the meeting:

- Will Safety and R&D both need more staff and funds to carry out the necessary new initiatives? For example, Safety will likely need more staff to conduct PTC approvals and testing and PTC experts to work through implementation issues as they arise.
- It is not clear whether issues concerning human factors are being addressed in relation to all the elements of PTC systems that have to be brought together. Presentations by FRA at the March and November 2008 meetings focused on HSI and development of a new simulator—the Cab Technology Integration Lab (CTIL). Will HSI and the CTIL be used for critical incident simulations for PTC training? Are BNSF's operation of ETMS and Amtrak's use of ACSES sufficient for proof of concept, or are there other plans? What are the significantly

different risks and rewards for ETMS I versus ETMS II, and similarly for ACSES I versus ACSES II?

- Generic and specific processes for technology transition from R&D to marketplace and deployment have not been fully explained. There are sole-source providers of some hardware. The handheld employee-in-charge device, which is important in preventing incursion into established work zone limits and is a requirement for PTC, is still being tested. No one yet makes it. How will it be brought to the marketplace within the required time frame? To date, the freight railroads have been working with suppliers to get the equipment they need, but that approach may not be sufficient given the large-scale deployment of PTC. A related question is whether existing suppliers can meet the quantity (and quality) requirements for the unprecedented scale and timetable of nationwide PTC roll-out.
- A strategic issue relates to the requirement in RSIA for PTC installation on any line with passenger service. Will the cost of PTC be a negative factor for states and others that want to extend passenger service on lines with light-density freight service?

### **Nationwide Differential GPS**

Continued funding for completion, operation, and maintenance of the Nationwide Differential GPS (NDGPS) as an enabling technology for PTC was supported in the 2006 workshop proceedings and the committee's letter report of April 29, 2008. An assessment conducted by RITA in 2008 confirmed the role of NDGPS as a national utility with operational requirements set by many agencies and organizations. For FRA, its value is seen for safety system requirements, particularly for PTC. FRA and other agencies and organizations have transportation research requirements for inland NDGPS. In the overall scheme of things, the funding needed for NDGPS is small in comparison with the benefits that will accrue.<sup>6</sup>

**Recommendation 2.** FRA should help build the case for NDGPS funding by linking the needs to big projects such as PTC and rail right-of-way mapping, and it should urge the U.S. Department of Transportation to find the funds to complete, operate, and maintain the system. Additional resources should be made available for the development of high-accuracy NDGPS to support R&D efforts related to capacity, speed, technology

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<sup>6</sup> For example, the \$5 million appropriated for FY 2009 was insufficient, resulting in a \$400,000 shortfall for O&M costs. A one-time recapitalization of the system, required for any operational scenario, would be in the \$3.5-4-million range to cover the costs of deferred maintenance.

upgrades, redundancies, reliability, and availability determinations.

### **Energy Efficiency and Environmental Issues**

A focus on energy efficiency and the environment is timely in light of the new administration's priorities, and support for related work can build on the energy efficiency of railroads. The President's support for high-speed rail, for example, is related to reduced energy needs and pollution. FRA has funded some projects, but there is frustration with the lack of attention to rail energy issues on the part of the Department of Energy (DOE). The industry is giving much attention to what can be done in relation to alternative power sources. Some railroads have received DOE project funding, but DOE is much more focused on motor vehicles.

**Recommendation 3.** Better coordination on rail-related research between FRA and DOE is needed. FRA should provide information to DOE on the importance of rail research, and it should attempt to coordinate more joint efforts with the industry.

### **Tank Cars**

Under considerable pressure from Congress and the railroads, and after an intense period of research and analysis, FRA issued a notice of proposed rulemaking for new tank car design standards in April 2008. The industry responded with significant objections to the proposed standards and expressed a need for an interim standard rather than a new design. To FRA's credit, the rule was modified, and an incremental approach that will not require large changes was adopted. FRA now reports that it will continue work in this area and that it will place more emphasis on the evaluation of risks from rail transport of hazardous materials.

**Recommendation 4.** FRA should continue to work on design standards that can reduce accidental releases for the next-generation tank car. This work may be best advanced by joining some of the industry projects already under way. The committee supports FRA's plans for further risk evaluations related to the rail transport of hazardous materials.

### **Network Capacity Analysis**

FRA is planning an initiative for forecasting freight and increased passenger traffic. Such analysis is timely and welcome. Among the factors to be considered, in addition to the mixing of freight and passenger traffic

mentioned previously, are indications that freight flows out of Asia began changing in response to last year's high fuel costs, Southern California congestion, and planned expansion of the Panama Canal. Changes in freight flows could have profound impacts.

**Recommendation 5.** The committee encourages FRA to pursue its initiative for improving the accuracy and usefulness of rail traffic forecasts. Passenger forecasting will be easier, but freight flows are undergoing substantial changes, and freight volumes and trade lanes will not repeat those of the past decade. Factors to be considered include the inability to forecast coal flows without knowledge of possible carbon taxes, increased development of renewable and nuclear sources of power, and causes of shifts in trade patterns.

### **Funding for the Facility for Accelerated Service Testing**

The committee questioned FRA about R&D's decision to cut drastically the funding it provides for the Facility for Accelerated Service Testing (FAST) at the Transportation Technology Center (TTC), in Pueblo, Colorado. FRA has supported FAST for many years with significant amounts of funding, but in recent years concerns have been expressed within FRA that too much of FRA's funding is going to overall operational costs for FAST and is thereby subsidizing for-profit work that the Transportation Technology Center, Inc. (TTCI) conducts for suppliers. The committee notes the coming increase in intercity passenger trains, many of which will operate jointly with HAL freight traffic, for which FAST testing will be critical. The FAST research directly addresses the safety of track components under heavy axle loads and is relevant for higher-speed passenger train operations. With new requirements for R&D to support PTC and high-speed rail development and with more resources for R&D, reconsideration of the amount and structure of funding for FAST may be timely.

### **CONCLUSION**

On behalf of the committee, I again thank the FRA staff who continue to work so industriously with the committee. We look forward to a continued cooperative association with Magdy El-Sibaie and FRA R&D staff in performing reviews of FRA's R&D activities.

Many new challenges are being faced with large-scale investments in PTC and high-speed rail. Lead time for R&D discoveries and deployment is key to the success of FRA's programmatic activities as well as its research

priorities. In an uncertain world that can move quickly, it is important to have R&D results ready to apply to new opportunities.

Sincerely yours,

Robert E. Gallamore  
Chair, Committee for Review of the FRA Research and Development Program

Enclosures

## Enclosure 1

### Committee Roster November 13-14, 2008, and March 12-13, 2009, Meetings

#### Chair

Dr. Robert E. Gallamore  
The Gallamore Group, LLC  
November 13-14, March 12-13

#### Committee

Dr. Christopher P.L. Barkan  
Associate Professor and Director  
University of Illinois  
November 13-14; March 12 via teleconference

Mr. Vernon W. Graham  
President  
Dakota, Minnesota and Eastern Railroad  
November 13-14

Mr. Craig Hill  
BNSF Railway Company (retired)  
November 13-14

Mr. Anson C. R. Jack  
Director of Policy, Research and Risk, and Deputy  
Chief Executive  
Rail Safety and Standards Board  
November 13-14

Mr. Charles R. Lynch  
Vice President, Operations Manager South  
Gannett Fleming Transit & Rail Systems  
November 13-14, March 12-13

Mr. James W. McClellan  
Vice President  
Woodside Consulting Group  
November 13-14, March 12-13

Ms. Audrey Milroy  
Director, Transportation Systems  
QTEC, Inc.  
November 13-14, March 12-13

Dr. Richard W. Pew  
Principal Scientist  
BBN Technologies  
November 13-14, March 12-13

Dr. Ian P. Savage  
Distinguished Senior Lecturer  
Northwestern University  
March 12-13

Mr. Patrick B. Simmons  
Director, Rail Division  
North Carolina Department of Transportation  
November 13-14, March 12-13

Mr. James Stem  
National Legislative Director  
United Transportation Union  
November 13-14

Mr. Gerhard A. Thelen  
Vice President, Operations Planning & Support  
Norfolk Southern Corporation  
November 13-14, March 12-13

#### Liaisons

Mr. Roy A. Allen  
President  
Transportation Technology Center, Inc.  
November 13-14; March 12-13 via teleconference

Mr. Gary Carr  
Chief, Track Research Division  
Federal Railroad Administration  
November 13-14, March 12-13

Mr. Thomas Peacock  
Director, Operations and Technical Services  
American Public Transportation Association  
November 13-14, March 12

## Enclosure 2

### Invited Speakers and Guests at November 13-14, 2008, and March 12-13, 2009, Meetings

#### Federal Railroad Administration

Mark Yachmetz, Associate Administrator for Railroad Development (November 13, March 12)

Jo Strang, Associate Administrator for Safety (November 13); as Acting Deputy Administrator (March 12)

Wynne Davis, Director, Program Planning and Evaluation, Office of Railroad Development (March 12)

Magdy El-Sibaie, Director, Office of Research and Development (November 13-14, March 12-13)

Gary Carr, Chief, Track Research Division, Office of R&D (November 13-14, March 12-13)

Sam Alibrahim, Chief, Signal, Train Control & Communications Division, Office of R&D  
(November 13-14, March 12-13)

Kevin Kesler, Chief, Equipment and Operating Procedures Research Division, Office of R&D  
(March 12-13)

Olga Cataldi, Senior Electronics Engineer, Office of Safety (March 12-13)

John Punwani, Program Manager/Train Occupant Protection (Locomotives) (November 13-14,  
March 12-13)

Eloy Martinez, Program Manager/Occupant Protection (Passenger) (November 13-14, March  
12-13)

Thomas Raslear, Staff Director/Operator Performance (November 13-14, March 12-13)

Francisco Gonzalez, Program Manager/Hazardous Materials (November 13-14, March 12-13)

Michael Coplen, Program Manager/Human Factors (November 13-14)

Mike Jones, Program Manager/Human Systems & Technology (November 13-14)

Leonard Allen, Program Manager/Intelligent Railroad Systems (November 13)

Ali Tajaddini, Program Manager/Track-Train Interaction (November 13-14)

Terry Tse, Program Manager/Train Control (November 13-14, March 12-13)

Leith Al-Nazer, Program Manager (November 13-14)

Melissa Shurland, Program Manager/Equipment (November 13-14)

Monique Stewart, Program Manager/Rolling Stock & Component Safety (November 13-14,  
March 12-13)

Karen McClure, Analytical Systems, Intermodal Specialist, Office of Policy and Communications  
(November 13-14)

Sean Mehrvarzi, Program Manager/Railroad Security (November 13-14)

**Volpe National Transportation Systems Center, Research and Innovative Technology Administration (RITA)**

Robert Dorer, Director, Physical Infrastructure Systems (November 13-14, March 12-13)

Jeff Gordon, Structures and Dynamics Division (November 13-14)

David Jeong, Mechanical Engineer (November 13-14)

Michael Coltman, Chief, Structures and Dynamics Division (November 13-14, March 12-13)

Brian Marquis, Structures and Dynamics Division (March 12-13)

Dee Chappell, Staff Engineer, System Engineering and Safety Division (March 12-13)

**RITA**

Karen Van Dyke, Director, Positioning, Navigation, and Timing (Acting) (March 12 via teleconference)