



Reviewing Federal Railroad Research, Development, and Demonstration Programs: Letter Report #5

DETAILS

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 **TRANSPORTATION RESEARCH BOARD**
OF THE NATIONAL ACADEMIES

May 1, 2007

The Honorable Joseph H. Boardman
Administrator
Federal Railroad Administration
1120 Vermont Avenue, N.W.
Washington, DC 20590

Dear Administrator Boardman:

The Transportation Research Board's (TRB) Committee for Review of the Federal Railroad Administration (FRA) Research, Development, and Demonstration Programs held its fifth and final meeting on March 22–23, 2007, in Washington, D.C. Attending committee members are listed in Enclosure 1, and participating FRA and Volpe staff in Enclosure 2.

This committee's work began in September 2005 as a follow-on to that of prior committees¹ having similar charges. Approximately half of its membership was carried over from the predecessor committee, with the remaining members, including the chair, being newly appointed.

This committee was charged with continuing peer reviews of FRA's research, development, and demonstration² programs and with conducting a conference on railroad research needs in spring 2006. With an update of the 2002 *Five-Year Strategic Plan for Railroad Research, Development, and Demonstrations* under way, FRA had two goals in mind for a new five-year plan to be issued in 2007: seeking input from a broad range of the

¹ The Committee for Review of the FRA Research and Development Program conducted reviews of the safety-related Railroad R&D Program and the Next-Generation High-Speed Rail Demonstration Program from 1998 to 2001. The scope of that committee's work expanded, and it became the Committee for Review of the Federal Railroad Administration (FRA) Research, Development, and Demonstration Programs, which served from 2002 to 2005.

² The committee's focus has evolved to encompass the R&D program only. Although the committee was charged with reviewing the Next-Generation High-Speed Rail Demonstration program, that program was not reauthorized in 2005, and remaining projects were transferred to the R&D Program. The committee and its FRA sponsors found that no peer review was required for the Magnetic Levitation Technology (Maglev) Deployment Program, which is primarily a funding mechanism for earmarked projects.

programs' customers and stakeholders, and identifying strategic directions beyond the agency's focus on safety R&D in recent years.

In April 2006, the committee held a Workshop on Research to Enhance Rail Network Performance, designed to meet both of these goals. The committee selected three critical issues—safety, capacity, and efficiency—as organizing themes for the workshop, with the synergy among them providing a perspective on the overall rail system. The committee understood its charge for the workshop from FRA as obtaining input on a potentially broader range of research beyond safety for the longer term, while also recognizing that for the foreseeable future, the agency's R&D will be predominantly safety-related.

The committee's process for planning and conducting the workshop and for organizing and prioritizing future research directions for FRA's consideration are summarized in the workshop report—TRB's Conference Proceedings on the Web 3, *Research to Enhance Rail Network Performance* (the full text of the report is available at <http://onlinepubs.trb.org/onlinepubs/conf/CPW3.pdf>). The report also details the committee's findings and recommendations on FRA's research directions. Prior to its March 2007 meeting, the committee asked FRA R&D program management to present the agency's responses to those findings and recommendations. The findings and recommendations, FRA's responses, and related topics discussed at the March meeting are used to structure this letter report.

The committee wishes to thank those who participated in and contributed to its March meeting, including Mark Yachmetz, Jo Strang, Jane Bachner, Claire Orth, and Gary Carr of FRA; Robert M. Dorer of the Volpe Center; and other members of the FRA R&D staff. Without the full cooperation of FRA management and staff, the committee would be unable to fulfill its charge. It should be noted that FRA is now actively recruiting a new director for the Office of R&D, who is expected to be in place by July. In turn, the new director will be responsible for filling two new subordinate manager positions. This letter report contains some references to activities that are on hold until the new director is hired.

FRA'S RESPONSES TO THE COMMITTEE'S RECOMMENDATIONS FOR THE AGENCY'S R&D PROGRAM MANAGEMENT

Where FRA Takes the Lead. FRA staff recognize the need to select research that is appropriate for public funding, and will continue to work with the committee and industry to improve its review and coordination of

research priorities. Continued outreach to the program's customers and stakeholders will be part of the decision-making process.

Avoiding Undue Fragmentation or Scattering of Research. The committee continues to be concerned about a large number of small projects in some program areas that may be fragmenting research resources. In the workshop report, the committee recommended that one potential means of minimizing scattering of research resources would be to use scoping studies as a screening mechanism for future research topics. The committee believes that scoping studies and the publication of related white papers could enhance the results of the screening and selection process and yield such additional benefits as more support for the program. FRA staff offered to provide a detailed presentation on existing processes for setting, selecting, and scheduling research priorities at the committee's next meeting. FRA staff also indicated that they plan to move toward phased studies with more focused schedules and interim products as a way to improve the structure of the program. The committee looks forward to FRA's presentations on its current and planned approaches.

For its March meeting, the committee requested presentations on particular R&D activities for which FRA would like the committee's comments or reactions. The resulting project profiles, however, are difficult for the committee to assess because the presentations did not include the context for each activity within the major program areas. For its next meeting, the committee requests an overview of each program area providing the context for individual projects under way and being planned. The committee found the new "quadrant" format used for some project summaries presented at the March meeting to be helpful, but believes such summaries could be better integrated with contextual material, especially with regard to program priorities.

Meeting Expectations. Participants in the 2006 workshop offered diverse perspectives on research and technology topics and welcomed the opportunity to express their views. This opportunity raised the expectations of the workshop participants and other customers and stakeholders of FRA's R&D program, who are awaiting further information on how the workshop outcomes will be reflected in the agency's 2007 update of its five-year strategic plan and in future budget requests. The committee recognizes the merits of postponing these decisions until the new R&D director is on board.

Regulatory Issues in R&D Implementation. Exploring the extent to which FRA regulations may impede the implementation of new technology continues to be within the purview of the Office of Safety, not the Office of R&D. In this regard, the committee is gratified to see a closer working relationship between the two offices, which clearly share FRA's main priority

of promoting safety. The two are working closely on research related to the Human Factors Safety Action Plan to develop a safety risk reduction program. This plan is premised on using precursor (or predictive) data to identify and offset safety risks and employing nonenforcement approaches in addition to regulatory enforcement. The larger question is whether an agency can be both a regulator and a facilitator of safety, and the committee recognizes that this may be a difficult balance to achieve. The committee awaits further development of the safety risk reduction program, with particular interest in how regulatory and nonregulatory elements can be truly complementary.

The committee is encouraged that FRA is developing a nontraditional R&D function by providing staff support for new safety initiatives and educating staff by rotating them between the two offices. The transition to the safety risk reduction program will help promote a beneficial culture change for the agency.

An exciting example of FRA's commitment to supporting new technology with anticipated benefits for capacity and efficiency as well as safety is the planned testing of electronically controlled pneumatic (ECP) brakes. Cooperation between the Office of Safety and the Office of Policy facilitated FRA's recent issuance to two railroads of a safety waiver for long-distance coal and intermodal movements using ECP brakes. By increasing the condemnation limit for brake shoe thickness from three-eighths to one-half inch, this waiver will allow the two participating railroads to run 3,500 miles between brake tests instead of the 1,500-mile intervals required by current regulations. Locomotives and cars will be equipped with ECP brakes on two dedicated trains. Once these trains are in operation, data will be collected on operating efficiencies and costs to determine whether new ECP braking systems are worthwhile investments for the industry. Benefit and cost measurements will also be needed for incorporation into a rulemaking for new safety regulatory provisions allowing the use of the technology.

COMMITTEE'S ENDORSEMENT OF CONTINUATION OR COMPLETION OF CURRENT FRA RESEARCH

The listing of recommended research directions in the next section is not meant to imply that current worthwhile research activities should be discontinued. Consistent with the predecessor committees' program reviews, this committee endorses the continuation or completion of the following activities.

Completion of the Nationwide Differential Global Positioning System (NDGPS) Network. This committee and its predecessors have consistently

recommended full funding for completion and maintenance of the NDGPS network to support the development and implementation of positive train control (PTC). The committee was disappointed to learn of FRA's conclusion that it should no longer house the NDGPS program, in part because the program could potentially draw funding away from R&D projects. FRA described NDGPS as "nice to have" but not necessary for PTC, as other technologies could serve the purpose. Although FRA recommended that NDGPS be adopted by other agencies from an overall transportation perspective, no funding has been requested for the program for fiscal year 2007 or 2008.

The committee's view is, however, that NDGPS would be beneficial for PTC systems in the future and that it would best be kept under government control. PTC systems are now being developed without NDGPS because its availability is not guaranteed. The committee is unconvinced that workaround designs currently being substituted for fundamental NDGPS technologies are an adequate solution. Vendors may have an incentive to develop proprietary positioning systems that would undermine industry interoperability and could be less accurate and reliable. Failure to fund NDGPS is an example of government suboptimization, and in the long run will make PTC less cost-effective.

Recommendation 1. The committee urges the U.S. Department of Transportation (USDOT) to actively seek other agency partners to continue funding for completion and maintenance of the NDGPS network. As the system now resides with the U.S. Coast Guard, the committee encourages discussions to this end with other units in USDOT, the Coast Guard, the Department of Homeland Security, and perhaps the Department of Agriculture.

Continued Development and Deployment of Positive Train Control Technology. The committee continues to be concerned about the overall slow pace of implementation of PTC. The next section on recommended research directions provides a more detailed discussion of this issue.

Continuation of Ongoing Fundamental Research on Key Railway Materials and Components, Including Materials and Designs for Equipment, Wheel–Rail Dynamics, Braking Technologies, and Wayside Detection Devices. The committee and FRA are in agreement on the importance of this type of research. Numerous examples were provided during the March meeting, particularly from the work of the Track Research Division.

Confidential Close Call Reporting System Demonstration Project.

This project is an important element of the safety risk reduction plan as a source of precursor data. The committee is encouraged to see that the first reporting site is up and running and that other sites are in the discussion or negotiation phase. Of concern, however, are the significantly higher-than-anticipated costs and the question of what funding sources can support the program if it is widely implemented.

Tank Car Safety and Hazardous Materials Risk Research. Tank car safety is currently the highest priority in R&D as the result of an accelerated schedule for new tank car regulations related to the transport of toxic inhalation hazard (TIH) materials. Based on information presented during the March meeting, the committee urges FRA to consider the following:

- The timing of expensive physical tests.³
- Whether or not car manufacturers have had an adequate role in the testing.
- Whether or not the regulatory impact analysis will address possible diversion to other modes, particularly truck, if the capital costs of the new cars are too high for relatively small (if any) payload increases.
- The extent to which minimizing the overall public risk of the transport of TIH materials has been considered through means such as USDOT's facilitating discussions among producers, carriers, and consumers (with antitrust immunity) aimed at reducing unnecessary truck and rail mileages for product delivery.
- Whether or not differences in the objectives of crash management energy tests of passenger cars and tests for tank car integrity have been taken into account in planning the tests.

³ The timing of the tests was still under discussion at the time of the March meeting. Questions raised included whether the testing is being done too soon and whether adequate time has been scheduled between the two planned tests for analysis of the results of the first test. The committee recognizes that the testing may be completed before this report is released.

RECOMMENDED RESEARCH DIRECTIONS

In planning the 2006 workshop, FRA charged the committee with synthesizing and prioritizing major research directions to be considered for the next five-year strategic plan based on the results of the workshop discussions. The following discussion is organized according to the committee's recommendations in the workshop report, starting with the highest priority. (More detailed recommendations for each of these research directions are included in the workshop report.)

Positive Train Control and Related Technologies. Progress is being made on PTC, with all the major U.S. railroads now pursuing PTC-related technology developments. In January 2007, the Electronic Train Management System (ETMS), jointly funded by BNSF Railway Company and FRA, was the first product safety plan to meet the requirements of the new safety rule as a nonvital safety overlay system.⁴

From the workshop discussions, the committee concludes that the role of FRA research in this area should be to identify and eliminate the technical and regulatory obstacles to migrating current and developing train control systems to a fully operational PTC system. In conjunction with the Association of American Railroads (AAR) and individual railroads, FRA is participating in a wide range of related R&D. The former Illinois project⁵ has been transferred to Vital PTC Development at the Transportation Technology Center, Inc., in conjunction with Lockheed Martin, the Railroad Research Foundation (an AAR subsidiary), and Norfolk Southern Railway. In light of the closure of the Illinois project, the committee is interested in documentation of lessons learned and successful products that resulted from FRA's \$20 million investment in that project. A number of successful features of the project were mentioned during the March meeting.

Recommendation 2. The committee recommends that FRA document the products resulting from the Illinois project and facilitate the transfer of these products to other railroad projects.

⁴ FRA's rulemaking on "Standards for Processor-Based Signal and Train Control Systems" (49 CFR Part 236, Subpart H) makes all railroads responsible for adopting a software management control plan for any new processor-based signal and train control equipment placed in service. Suppliers are implicitly responsible for accurate representations of their components and software.

⁵ The Illinois project was formally known as the North American Joint PTC Project, funded jointly by FRA, AAR, and the Illinois Department of Transportation. The project was intended to develop and demonstrate PTC on a line to be upgraded for high-speed passenger services.

Other PTC-related research recommended by the committee includes two major issues discussed at length by FRA staff at the March meeting: communications and interoperability. At the meeting, FRA reported failures of the communications systems for the Illinois and other projects while noting the critical importance of developing advanced high-capacity digital communications systems to support PTC. In FRA's view, communications problems must be solved before standards for interoperability are set. The committee generally agrees with FRA that new wireless communications technologies appear to hold promise for providing adequate capacity.

One lesson learned from the Illinois project is that there is more than one way to deploy a PTC system and to provide different combinations of functions. The Incremental Train Control System (ITCS) is being operated commercially in Michigan; ETMS just received approval from FRA, as mentioned above; the Alaska project is continuing to develop; and the Amtrak Northeast Corridor and New Jersey Transit Advanced Civil Speed Enforcement System (ACSES) are operating. Several other railroads are developing other systems with various vendors. PTC development has been largely vendor driven for the past 10 years, with little sharing of information (because so much of it is proprietary) and little encouragement for the railroads to start implementing available components on a wide scale.

Like the now-discontinued Illinois project, several FRA R&D projects currently under way are focused on developing interoperability in communications and PTC operations, along with enabling technologies (such as wireless communications) to enhance PTC functionality. Increased interaction among and interchange between carriers in recent years through such cooperative activities as joint-use trackage agreements, run-through operations, and locomotive pooling is evidence of the need for close attention to interoperability. There is no question that a certain degree of interoperability is necessary to allow locomotives from one railroad to operate on the facilities of another. Technology development has advanced to the point where standards setting is the appropriate next step. Opinions differ, however, about the priorities for interfaces and components of PTC and other systems that need to be interoperable, as well as about how, when, and by whom standards should be set.

Recommendation 3. The committee believes standards for interoperability are necessary, and encourages FRA to provide research assistance and guidance for the timely creation of standards for priority processes, interfaces, and components necessary for interoperable PTC and related systems.

Performance-Based Standards, Use of Benefit/Cost and Risk-Based Analysis, and Improved Accident/Incident Data. Performance-based safety standards can benefit the implementation of new technology in some areas. Setting these standards is the responsibility of the Office of Safety. FRA expects that the new tank car safety rule will be largely performance-based. The committee encourages the Office of R&D to provide research support for the development of new performance-based standards by the Office of Safety. In some cases, testing of new technology or equipment—such as the testing of ECP brakes discussed earlier—may provide data to support new standards.

Highway–Rail–Intersection Safety and Trespasser Casualty Mitigation. FRA agrees on the priority of research in this area in view of the significant hazards presented by grade crossings and the fact that trespassers now account for more fatalities than motor vehicle–train collisions at crossings. Although FRA has established commendable goals and actions to be supported by such research, this research area appears to be fragmented into many small projects (see the earlier discussion of fragmentation and scattering of research resources). The committee would benefit from an overview illustrating how these individual research efforts fit into a larger design.

At the March meeting, mention was made of future work designed to bring intelligent transportation systems (ITS) and PTC development together in relation to crossing protection, a concept of particular interest to the committee. The committee would appreciate additional discussion of grade-crossing and trespasser research at its next meeting, with emphasis on combined efforts by FRA, industry, state agencies, and/or the Federal Highway Administration. This discussion could be complemented with the overview of the relationships between the individual research projects and the larger research design.

Human Resource Management. In the workshop report, the committee recommended that FRA's research contribute to a consistent approach and improved tools for the railroads' own analyses related to human resource management. FRA has indicated that any work in this area will be within the purview of the new Human Factors Research Staff, whose leadership will be selected after the new R&D director has been hired.

Network Capacity Analysis. As mentioned above, the themes of the workshop were safety, capacity, and efficiency and their interrelationships. Safety benefits can result from capacity improvements, for example, and vice versa. The Office of Policy has insufficient funds to pursue work in this area, and thus any such investment would need to come from R&D. The

committee reiterates the following recommendation from the workshop report:

Recommendation 4. The committee recommends that FRA, through the Office of R&D, provide tools for use by industry and government agencies to (1) develop means to determine capacity, (2) formulate metrics for measuring capacity improvements, and (3) develop a methodology for quantifying the benefits of public investments in rail network capacity to support public-private partnerships.

Energy Efficiency and Environmental Issues. The committee notes ongoing research for which fuel efficiency and fuel management are cited as potential benefits. This research includes the LEADER program, which is now being implemented by some railroads; PTC; and alternative-fuels locomotives. The tank car safety program clearly has environmental implications, as does the development of thermoplastic crossties through the use of recycled materials and elimination of the use of creosote, which can be detrimental to the environment.

Recommendation 5. The committee recommends that FRA, without necessarily increasing R&D expenditures, consolidate findings and research results related to energy and environmental issues from research projects undertaken in all areas. Doing so could highlight not only the benefits of completed research, but also needs for additional research that might be undertaken by FRA, other appropriate agencies, or industry.

CONTEXTUAL OR POLICY RESEARCH

In the preface to the workshop report, the committee referred to prior letter reports and recommendations to FRA as part of the context for the content of the workshop. Those earlier recommendations included contextual or policy research to provide an understanding of rail industry trends and developments as guidance for future research directions. At the March meeting, Jane Bachner discussed recently completed and ongoing policy studies on railroad employee retention (performed in conjunction with human factors R&D staff), on blocked grade crossings (a congressionally requested study), and on the effect of rising oil prices on the rail industry. The latter study showed that with rising ethanol use, tank cars are in greater demand, with implications for changes in railroad logistics, capacity, and commodity mix. The committee is interested in future updates on this work. FRA may update a rail/truck efficiency study conducted 15 years ago to

reflect improvements in both locomotives and trucks; the committee encourages this important study.

The committee recognizes the limited resources available for FRA's policy work, but encourages the continuation of studies performed in conjunction with R&D and studies designed to help guide future R&D directions.

FUTURE COMMITTEE ACTIVITIES

FRA has requested that TRB continue providing a committee to conduct periodic peer reviews of the R&D program. TRB will reconstitute this committee later in the year, drawing primarily on the current membership while also appointing several new members. The new committee will hold an interim, informational meeting in fall 2007, with the purpose of introducing the new committee members and welcoming the new R&D program director and managers.

Following up on discussions at its March meeting, the committee would like to explore some topics in more detail and requests that FRA staff provide the following at the fall meeting:

- A presentation on the process for establishing research priorities, selecting research topics, and setting schedules
- A presentation on tracking the progress of projects
- An overview and framework for each program area, providing a context for individual research projects and outlining relative resource allocations within each area
- In particular, an overview and framework for ongoing research in the grade-crossing and trespasser area
- A presentation on combined efforts by FRA, industry, states, and/or the Federal Highway Administration with regard to grade-crossing and trespasser issues
- A presentation on the ownership of products resulting from FRA-funded PTC research and a discussion of how FRA can provide leadership for the transfer of such products to the marketplace for broader industry use
- A presentation on plans for coordination among ITS, crossing protection, and PTC systems

- Project presentations prepared in the quadrant format

CONCLUSION

On behalf of the committee, I again want to thank the FRA staff who continue to work so cooperatively with the committee. We look forward to a continued cooperative association with Mark Yachmetz, Jo Strang, the incoming R&D director and managers, and FRA R&D staff in performing additional reviews of FRA's R&D activities.

Sincerely yours,

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

Enclosures

Enclosure 1

Committee Roster with March 22–23, 2007, Meeting Attendance Noted

Chair

Dr. Robert E. Gallamore
Rehoboth Beach, Delaware
March 22–23

Members

Dr. Christopher P.L. Barkan
Associate Professor and Director
University of Illinois, Urbana-Champaign
(via teleconference)

Ms. Anna M. Barry
Director of Subway Operations
Massachusetts Bay Transportation Authority
March 22–23

Mr. Vernon W. Graham
Vice President, Engineering Operations
Canadian Pacific Railway Company

Mr. Craig Hill
Vice President, Mechanical and Value Engineering
Burlington Northern Santa Fe Railway

Mr. Anson C.R. Jack
Director, Standards
Rail Safety and Standards Board, United Kingdom

David D. King
General Manager
Triangle Transit Authority

Mr. Charles R. Lynch
Vice President, Transportation
Florida East Coast Railway Company
March 22–23

Mr. James W. McClellan
Virginia Beach, Virginia

Dr. Gerard McCullough
Associate Professor
University of Minnesota
March 22–23

Ms. Audrey L. Milroy
Systems Engineering, Subject Matter Expert
QTEC, Inc.
March 22–23

Dr. Thomas H. Rockwell
President
R&R Research, Inc.
(via teleconference)

Mr. James A. Stem, Jr.
Alternate National Legislative Director
United Transportation Union
March 22–23

Mr. Gerhard A. Thelen
Assistant Vice President—Mechanical
Norfolk Southern Corporation
March 22–23

Liaison Representative

Claire L. Orth
Chief, Equipment/Operating Practices
Research Division
Federal Railroad Administration
March 22–23

Mr. Roy A. Allen
President
Transportation Technology Center, Inc.
(via teleconference)

Enclosure 2

Invited Speakers and Guests at March 22–23, 2007, Meeting

Federal Railroad Administration

Mark Yachmetz, Associate Administrator for Railroad Development

Jo Strang, Associate Administrator for Safety

Jane Bachner, Deputy Associate Administrator for Policy (March 22)

Claire Orth, Chief, Equipment and Operating Procedures Research Division, Office of R&D

Gary Carr, Chief, Track Research Division, Office of R&D

John Punwani, Program Manager/Train Occupant Protection (Locomotives) (March 22)

Eloy Martinez, Program Manager/Occupant Protection (Passenger)

Thomas Raslear, Program Manager/Human Factors

Michael Coplen, Program Manager/Human Factors

Mike Jones, Program Manager/Human Factors (March 22)

Leonard Allen, Program Manager/Intelligent Railroad Systems

Ali Tajaddini, Program Manager/Track–Train Interaction (March 22)

Don Plotkin, Engineer, Office of Freight Programs (March 22)

Terry Tse, Program Manager/Train Control (March 22)

James Smalles, Program Manager/HSR, Grade Crossing (March 22)

Leith Al-Nazer, Program Manager

Melissa Shurland, Program Manager

Volpe National Transportation Systems Center

Robert Dorer, Deputy Director, Office of Surface Transportation Programs