



## Reviewing Federal Railroad Research, Development, and Demonstration Programs: Letter Report #3

### DETAILS

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May 13, 2004

The Honorable Allan Rutter  
Administrator  
Federal Railroad Administration  
1120 Vermont Avenue, N.W.  
Washington, DC 20590

Dear Administrator Rutter:

The TRB Committee for Review of the Federal Railroad Administration (FRA) Research, Development, and Demonstration Programs held its fourth meeting on December 4–5, 2003, and its fifth meeting on April 1–2, 2004, both in Washington, D.C. The committee members who attended each of these meetings are listed in Enclosure 1; the speakers and guests at each meeting are listed in Enclosure 2.

The committee thanks Mark Yachmetz, Jo Strang, Jane Bachner, Magdy El-Sibaie, Claire Orth, Robert McCown, and other FRA and Volpe Center staff for their continued cooperation and substantial participation in these meetings. The presentations and materials they have provided are essential to the committee's work.

### **THE COMMITTEE'S CHARGE**

FRA's overall charge to the committee is to conduct periodic peer reviews of three programs:

- The Railroad Research and Development (Railroad R&D) Program
- The Next Generation High-Speed Rail Technology Demonstration (NGHSR) Program
- The Magnetic Levitation Technology (Maglev) Deployment Program<sup>1</sup>

These peer reviews are intended to address (1) the agency's R&D management structure and approach; (2) the current direction and allocation of funds to the various

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<sup>1</sup> By agreement with FRA, the Maglev Deployment Program was not discussed at this meeting because there are no decisions pending on the future of the program to which the committee could make a contribution. The committee has reviewed the program in the past, and the committee's findings have not changed from those expressed in the May 29, 2002, and April 22, 2003, letter reports.

program areas; and (3) whether the programs reflect an appropriate balance of federal, state, and private-sector input and cost sharing.

In keeping with its charge, prior meetings of this committee have been focused almost entirely on detailed reviews of ongoing research in each of the major R&D programs and in specific program areas. One exception was a request by FRA in April 2003 for the committee to begin considering possible new directions for the NGHSR program because many of the major projects under that program were nearing completion. FRA staff proposed that the April 2004 meeting take a somewhat different direction from the past, focusing on a longer-range outlook within which program changes would be possible in the Railroad R&D and NGHSR programs. The committee appreciates the initiative of Jo Strang and Mark Yachmetz to redirect the dialogue to future considerations and to seek the committee's recommendations on program changes that can be reflected in future budget requests.

In the next section of this report, the committee offers broad observations and recommendations on the overall direction of FRA's research, development, and demonstration programs. The third section focuses on some specific areas currently in progress or being planned within the Railroad R&D Program that the committee endorses. The fourth section addresses FRA's request for recommendations on future directions for the NGHSR program. The fifth section covers comments on contextual research. The final section provides some suggestions for the committee's fall meeting.

## **OVERALL PROGRAM DIRECTION: NEED FOR CUSTOMER FOCUS AND COOPERATIVE EFFORTS**

In reviewing FRA's research, development, and demonstration programs, the committee concludes that the agency is serving a variety of customers. The committee believes the focus of these programs could be sharpened if the programs' customers and their R&D needs were identified more clearly, and relationships and projects that can meet those needs were defined.

In the committee's view, the customers of FRA's research, development, and demonstration programs fall into the following categories:

### **Railroad R&D Program**

- Internal
  - Office of Safety
  - Office of Policy
  
- External
  - Amtrak
  - Shortlines

- Class I freight railroads (for safety and topics related to public-interest issues)
- Commuter railroads

### **Next Generation HSR Program**

- Internal
  - Office of Safety
  - Office of Policy
- External
  - Amtrak
  - State and local agencies/passenger services
  - Freight railroads (for traffic and capacity interaction studies)

The committee believes the overall focus of research, development, and demonstration efforts could be improved through periodic and systematic outreach efforts to all of these customers. Customer involvement could be beneficial in broadening the base of support for the programs and in some cases attracting additional cost sharing. Having customers involved in the formulation and execution of research programs also should facilitate the dissemination and delivery of the research products and enhance prospects for the research being used and/or handed off. The committee expects that the growing congressional tendency to earmark project funds might be better managed if FRA were to strengthen its programs and reach out more directly to engage particular customers. In addition, the committee believes the experience gained through earmarked projects could be generalized and made more useful if the potential customers for such work were better defined.

**Recommendation 1.** The committee recommends that FRA identify more specifically the customers of various research, development, and demonstration programs and develop closer working relationships with these customers through periodic and systematic outreach. FRA should engage these customers throughout all stages of the research process, including problem identification, development of research topics, review and oversight during the conduct of research, and implementation. Additional opportunities for cooperative projects and cost sharing should be explored, and a more vigorous effort to share results should be made, perhaps through immediate posting of research reports on the web.

### **RAILROAD R&D PROGRAM**

The committee is impressed with the quality of work being done in a number of areas under the Railroad R&D Program, and some exciting ideas for future projects were put forth at the committee meeting. In particular, the committee would like to highlight the following.

**Proposal for a Pilot Study for a Close-Call Safety Monitoring and Reporting System.** This proposed 5-year project would be designed to collect and analyze data from close calls or near misses; such information can highlight potential safety issues before they lead to actual accidents, and permit analysis of safety data outside the fault-based arena. The proposed project could produce a proactive approach to preventing accidents and saving lives by developing methods to identify and manage risk. The committee has been encouraging attention to this concept and supports the creation of an opportunity to go beyond the current data collection system. The committee recognizes that the establishment of such a system poses challenges, particularly in earning the trust of all parties involved. Nonetheless, the system offers real promise as a means to make research relevant both to what is happening now and to what can be expected in the coming years as new technology is deployed in the railroad operating environment.

**Recommendation 2.** The committee strongly endorses the concept of developing a close-call reporting system and urges FRA to include this project in its budget, for fiscal year (FY) 2006 if possible. FRA must be aware of issues related to both current and future jobs. It is particularly important to ask the right questions and obtain data that can be analyzed to anticipate possible future safety issues. The committee is especially concerned about keeping human factors research relevant to the jobs or tasks being done, whose nature and content are subject to change, particularly as technology changes. As new tasks are defined, job safety analysis, fault tree analysis, and failure modes and effect analysis can be employed to eliminate system, procedural, and human errors before they occur.

**Locomotive R&D.** Energy, alternative fuels, emissions, and fuel efficiency are all issues of critical financial importance to the freight railroads, but they also have public-interest aspects related to pollution reduction and limitation of greenhouse gas emissions. FRA's objectives are improved safety and efficiency of operations with benefits to the environment. The agency's current and planned research projects include the following: the LEADER project, which is intended to help locomotive drivers perform correct train handling and thereby provide potential benefits of safer operations and improved fuel efficiency; the development of technology for measuring locomotive emissions in real time; and the development of alternative fuels and improvements to diesel engines to reduce emissions. The committee agrees that it is important for FRA to conduct R&D in these areas. These activities complement those of the Environmental Protection Agency (EPA), which sets emission standards for locomotives and is encouraging the railroads to explore alternative fuels, as well as those of the Department of Energy (DOE), which is concerned largely with energy efficiency.

**Recommendation 3.** The committee encourages FRA to undertake research related to energy, alternative fuels, emissions, and fuel efficiency

to support freight railroad operations related to safety and public-interest concerns. Outreach to freight railroads can help FRA select the most relevant technologies and options for research. For example, development of the hydrogen fuel-cell locomotive may have limited support in the rail industry and be better left to the Department of Defense (DOD), which already has allocated substantial funding for similar work. However, research on alternative fuels and on alternative emission-reduction strategies, such as partial engine ignition under low-load conditions, may have substantial direct and complementary benefits. FRA should also explore more-cooperative approaches with EPA and DOE on these issues. In this case, the locomotive manufacturers may also be a potential customer, especially for the adaptation the technologies studied to actual use in the industry.

**Development of Track Quality Indices.** The goals of this project are (1) to develop track quality indices (TQIs) that can be used to objectively assess and rate track conditions, relative to FRA track safety standards, that are inspected by FRA's research vehicles<sup>2</sup> and (2) to create a prototype real-time TQI display on the research vehicles. The committee sees this as highly useful work that needs to be continued and verified. TQI has the potential for many uses, including evaluating track maintenance work and providing additional data for maintenance management systems.

**Recommendation 4.** The committee believes the development of TQIs could lead to performance metrics that would be useful to both FRA and the industry, and therefore recommends that FRA continue this work. As the work progresses, the committee recommends that FRA consider linking the TQIs to other measures, including track exceptions, ride quality, and traffic volumes.

## FUTURE DIRECTIONS FOR THE NGHSR PROGRAM

FRA staff indicated that they are ready to shift the focus of this program away from high-speed rail, recognizing the reality that most customers for the research (Amtrak, regional compacts, states, and local authorities) with an interest in enhanced intercity rail passenger service are taking an incremental approach to achieving speeds of 90 to 110 mph. Without federal funds for major capital investments, intercity rail passenger services are being operated on and planned for existing freight lines. As discussed above, in redirecting this program, it is important for FRA to base new program initiatives on the needs of these customers, which are increasingly motivated to invest in technologies that will produce the "next-best minutes," or incremental improvements in

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<sup>2</sup> FRA operates several research vehicles that are used for track inspections. The T-16 car, in operation since 2000, is equipped with advanced track measurement and data collection technologies that function at speeds up to 160 mph. In addition, the T-18 car, to be delivered in May 2004, will be a self-propelled deployable gage restraint measurement system vehicle, operating at 35 mph.

trip times. After making investments in infrastructure and grade-crossing improvements, the agencies are looking for the most cost-effective ways to trim additional minutes off trip times. Technologies that potentially can provide these benefits include positive train control, lower-speed and lighter-weight tilt-body equipment for diesel or turbine operation, lower-cost electrification, and perhaps TMUs (a turbine-powered version of the DMU).

**Recommendation 5.** The committee recommends that FRA refocus the NGHSR program to support efforts by state and local agencies to achieve incremental improvements by developing and demonstrating technologies that can produce the “next-best minutes” in trip time savings. The committee recommends that a portion of the program redesign include formalized outreach so that FRA’s efforts will be closely tied to their customers’ articulated needs. This recommendation reinforces a similar statement in the committee’s April 22, 2003, letter report that redirection of the NGHSR program should be based on an assessment of current and near-term technology needs, a focus on incremental speed improvements and cost-effective investments to reduce trip times, and an analysis of capacity and joint operations issues between passenger and freight services.

**Diesel Multiple Units Compliance and Demonstration Project.** This earmarked project has received funding in the FY2003 and 2004 appropriations for nonelectric locomotive projects under the NGHSR program. A demonstrator trainset has been operating in revenue service for commuter rail, and a three-car trainset is scheduled for delivery in late 2004. In addition to commuter operations, diesel multiple units (DMUs) are a relevant type of equipment for states planning to start up intercity passenger services. In situations in which initial demand for intercity service may be low, the DMU is a lower-cost alternative to a locomotive-hauled train or electrical multiple units (EMUs) and thus lowers the cost barrier to entry into a market. Even though this is an earmarked project, it provides an opportunity to learn about the technology and collect performance data. It is important for serviceability and operating cost of the equipment to be proven. This principle of obtaining the maximum amount of information can be applied to many earmarked projects: even where the immediate objective is narrow, the lessons learned can be much more general.

**Recommendation 6.** Given the promise of DMUs for start-up passenger services, the committee recommends that FRA take full advantage of the opportunity to learn about this technology and collect performance data. Learning lessons from any earmarked project should be a standard part of FRA’s project management.

**Estimating Maintenance Costs for Mixed High-Speed Passenger and Freight Rail Corridors.** This cost model, now under development, is an essential tool for any effort to initiate passenger service in mixed traffic. Addressing capacity issues is critical for

successful mixed operations. Even though disagreements among the parties involved are likely, this model needs to be vetted among potential users and then provided as soon as possible.

**Recommendation 7.** The committee recommends that FRA proceed to complete the model for estimating maintenance costs for mixed high-speed passenger and freight corridors. To this end, FRA should vet the model with potential users and then publish it as soon as possible.

**Axiomatic Safety-Critical Assessment Process.** The committee remains concerned that the objectives for the axiomatic safety-critical assessment process (ASCAP) model have become overly ambitious. Echoing Recommendation 2 in the committee's April 22, 2003, letter report that this project should be more results oriented, the committee believes the model should be focused on its original objectives (risk assessment for certain aspects of automatic train separation systems) and the model should not be more broadly focused until its original objectives have been fully met.

## CONTEXTUAL RESEARCH

As the committee has discussed in several prior letter reports, R&D decisions can be better informed with more information about trends in railroad traffic—both increased volumes and the changing mix of commodities being moved. Highway capacity alone cannot handle the projected future growth in freight, and the resultant demands on railroad capacity need to be understood and anticipated. What volumes and mix of commodities should the railroads anticipate? How will changes in the mix of commodities affect railroad investments and operations, including related changes in the mix of train types? Such questions are relevant if R&D is to address the safety and efficiency of future operations.

For example, in 2003 FRA's Office of Policy commissioned the Volpe Center to prepare two white papers on "Rail Transportation of Grain" and Rail Transportation of Coal," which provide useful summaries of future trends for these commodities that have historically been so important to the railroads. Given the tremendous growth in intermodal transportation, this is an area warranting similar examination.

**Recommendation 8.** In light of the importance of intermodal traffic to freight railroads, the committee recommends that FRA conduct a study on future trends in intermodal traffic, similar to the highly useful studies on coal and grain that were carried out in 2003. FRA's recent study of the future of scheduled services in providing carload traffic for U.S. railroads also has implications for future R&D that deserve discussion with the industry.



FRA's Office of Policy is considering a study on changes occurring in the workforce. The committee encourages FRA to undertake a study that will examine changes in job functions related to the deployment of new technologies, including requirements for new skills.

**Recommendation 9.** New human factors issues arise as the nature of jobs change. The committee fully endorses FRA's plan to undertake a study of changes in the workforce. The results of this work should be an important complement to the agency's human factors safety research. This study should anticipate the workforce of the future, say in 10 years, and what jobs they will be doing. For example, locomotive drivers will be required to deal with more-automated systems in the locomotive cab and with more-advanced train control systems. Future safety issues related to new technology and associated failure modes should be considered in an attempt to solve tomorrow's problems in advance. The concepts for such a study relate to the committee's recommendations for examining changing trends in commodities, types of trains and operations, and implications for drivers.

In the broadest context, the role of railroads within the transportation system needs to be examined and understood. Transportation is a vital element of the nation's growing economy. The highway and air modes are dependent on government programs of ownership of rights-of-way, ownership of traffic control systems, and oversight of safety and security systems; the railroad system, on the other hand, is largely privately owned and operated and receives very limited local, state, and federal funding. Yet the rail system provides lower-risk, lower-cost, and lower-energy transportation. As issues of congestion, fuel availability, and pollution become more pressing, full consideration must be given to the role of all the modes in addressing these issues.

## **SUGGESTIONS FOR THE FALL MEETING**

The committee would like to hear about other research programs, such as those of the Federal Highway Administration and the Federal Transit Administration, as well as cooperative research programs, European rail research, and perhaps others, that may offer lessons on serving customer needs. The committee would also appreciate a briefing on FRA's study of the future of scheduled carload traffic for railroads and, by implication, future trends in unit train traffic for various markets and commodities.

## **CONCLUSION**

On behalf of the committee, I again want to thank the FRA and Volpe staff who continue to work so cooperatively with the committee. We look forward to a continued cooperative association with you, Mark Yachmetz, Jo Strang, and the FRA staff.

Several members of the committee and I would like to meet with you personally at your earliest convenience to discuss the findings and recommendations contained in this report.

Sincerely yours,

Louis S. Thompson  
Chair, Committee for Review of the FRA Research, Development, and Demonstration Programs

Enclosures

Enclosure 1

**Committee for Review of the Federal Railroad Administration  
Research, Development, and Demonstration Programs**

**Committee Members Attending December 4–5, 2003,  
and April 1–2, 2004, Meetings**

Chairman

Mr. Louis S. Thompson  
Principal  
Thompson, Galenson and Associates, LLC  
December 4–5  
April 1–2

Members

Ms. Anna M. Barry  
Director of Railroad Operations  
Massachusetts Bay Transportation Authority  
December 4–5  
April 1–2

Mr. Christopher J. Boon  
President  
Boon, Jones, and Associates, Inc.  
December 4–5  
April 1–2

Dr. Sherwood C. Chu  
Bethesda, MD  
April 1–2

Dr. William J. Harris, Jr.  
Arlington, VA  
April 1–2

Mr. Craig Hill  
Vice President, Chief Systems  
Maintenance Officer  
Burlington Northern Santa Fe Railway  
December 4–5

Mr. David D. King  
Deputy Secretary for Public Transportation  
North Carolina Department of Transportation  
December 4–5  
April 1–2

Mr. Kenneth L. Lawson  
Bluemont, VA  
December 4–5  
April 1–2

Dr. Gerard McCullough  
Associate Professor, Applied Economics  
University of Minnesota  
December 5

Dr. Thomas H. Rockwell  
President  
R&R Research, Inc.  
December 4–5

Mr. Thomas P. Schmidt  
Jacksonville, FL  
December 5  
April 1–2

Mr. Gerhard A. Thelen  
Assistant Vice President – Mechanical  
Norfolk Southern Corporation  
December 4  
April 1–2

Mr. William C. Thompson  
Vice President  
Jacobs Engineering  
December 4–5  
April 1–2

Liaison Representative

Claire L. Orth  
Chief, Equipment/Operating Practices Res. Div.  
Federal Railroad Administration  
December 4–5

**Invited Speakers and Guests at  
December 4-5, 2003, and April 1-2, 2004, Meetings**

**Federal Railroad Administration:**

Mark Yachmetz, Associate Administrator for Railroad Development (December and April)

Jo Strang, Deputy Associate Administrator for Railroad Development (December and April)

Jane Bachner, Deputy Associate Administrator for Policy (December and April)

Claire Orth, Chief, Equipment & Operating Procedures Research Division, Office of R&D (December)

Magdy El-Sibaie, Chief, Track Research Division, Office of R&D (December and April)

Sean Mehrvarzi, Program Manager/Railroad Security (April)

Sung Lee, Program Manager/Track and Structures (April)

Jose Peña, Program Manager/Hazardous Materials Transportation (April)

John Punwani, Program Manager/Train Occupant Protection (Locomotives) (December and April)

Monique Stewart, Program Manager/Rolling Stock & Component Safety (December and April)

Tom Tsai, Program Manager/Train Occupant Protection (Passenger) (December and April)

Thomas Raslear, Program Manager/Human Factors, Office of R&D (December and April)

Michael Coplen, Program Manager/Human Factors, Office of R&D (December and April)

Robert McCown, Acting Chief, Program Development Division, Office of Railroad Development (December and April)

Leonard Allen, Program Manager/Intelligent Railroad Systems (December)

Mahmood Fateh, Program Manager/Track and Structures (December)

Ali Tajaddini, Program Manager/Track/Train Interaction (December and April)

Don Plotkin, Program Manager/Track and Structures (April)

Steve Sill, Program Manager/HSR, Technology (December and April)

Terry Tse, Program Manager/Train Control (December and April)

James Smailes, Program Manager/ HSR, Grade Crossing (December and April)

Karen McClure, Industry Economist, Office of Policy (December)

John Murphy, Staff Director, Labor and Special Programs, Office of Policy (April)

Arnold Kupferman, Magnetic Levitation Technology Deployment Program (December)

**Volpe National Transportation Systems Center:**

Robert Dorer, Acting Deputy Director, Office of Safety and Security (December and April)

Michael Coltman, Chief, Structures and Dynamics Division (December and April)

**American Association of State Highway and Transportation Officials**

R. Leo Penne, Program Director, Intermodal & Industry Activities (December)

**Transportation Technology Center, Inc.:**

Roy A. Allen, President (December)

Ruben Pena, Manager, Business Development (December)

**National Transportation Safety Board:**

Ron Hynes, Associate Director–Railroads, Office of Railroad, Pipeline and Hazardous Materials (December)

Gerald Weeks, Associate Director–Human Performance and Survival Factors, Office of Railroad, Pipeline and Hazardous Materials (December)