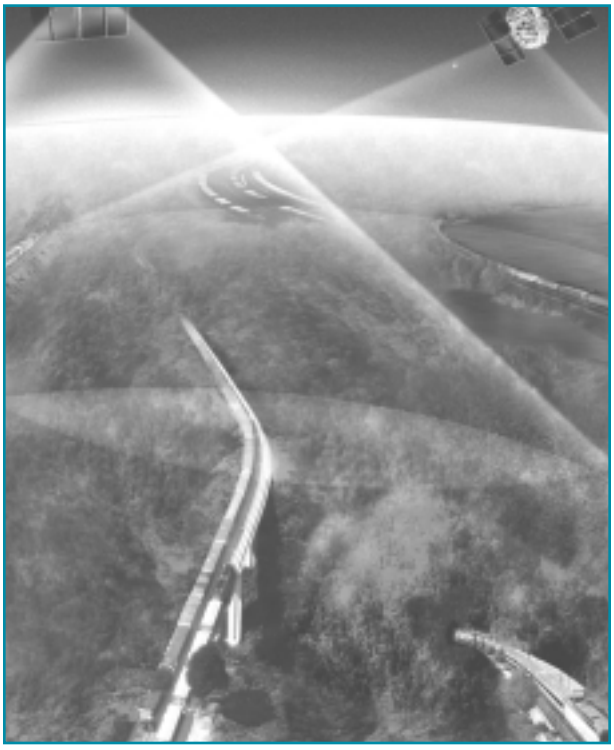
INTRODUCTION

The first priority of the Federal Railroad Administration (FRA) is the safety of the United States railroad system, which, in 1996, included 173,000 route miles of track, 19,270 locomotives, 6,500 passenger cars, 1,240,000 freight cars, and 205,000 employees. The demands on this system are continuously growing, and changing technologies provide the opportunity to improve system effectiveness and efficiency. The FRA addresses safety concerns in all phases of railroad operations, through research and development, regulatory, and enforcement activities to ensure that railroads in the United States continue to be among the world's safest.



FRA Office of Railroad Development projects contribute vital inputs to the FRA's safety regulatory processes, to railroad suppliers, to railroads involved in the transportation of freight, intercity passengers and commuters, to railroad employees and their labor organizations, and to states and municipalities. FRA-owned facilities

Photograph courtesy of Bombardier, Inc. Transportation Equipment Group

provide the infrastructure necessary to conduct experiments, test theories, concepts, and other technologies in support of the research and development program. Every attempt is made in research and development planning to anticipate and prevent potential safety threats. The emphasis is on producing technically and economically sound countermeasures to ensure the continued and enhanced safety and efficiency of railroad transportation.

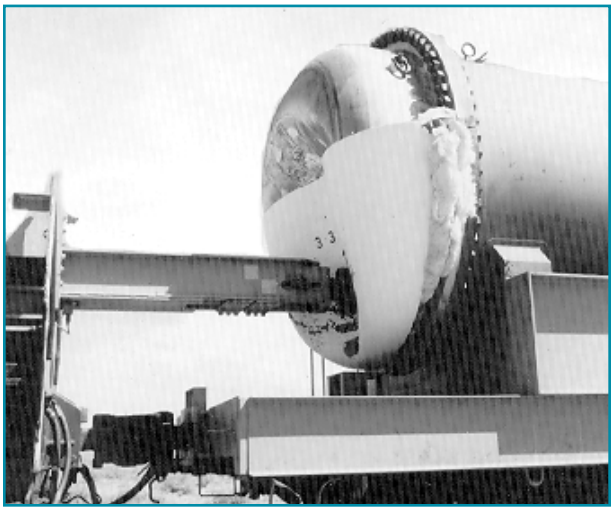
In supporting the safety mission of the agency, FRA's Office of Railroad Development looks toward rail transportation for the 21st Century. Issues include ensuring that the safety implications of the following industry trends are known:

- changing tank car design
- faster and heavier rail cars
- new passenger and crew space designs
- increasing passenger train speeds
- increasing mixed passenger/freight operations
- new braking systems for both passenger and freight train consists
- improved rolling stock on-board and wayside detection systems
- more complex equipment and systems

The FRA, in an effort to ensure maximum leveraging of research funds and to eliminate duplication, cooperates extensively with the Association of American Railroads (AAR), the Railway Progress Institute (RPI), American Public Transit Association (APTA), the National Railroad Passenger Corporation (Amtrak), the Transportation Research Board (TRB), and government agencies such as the Federal Transit Administration (FTA), the Federal Aviation Administration (FAA), and the National Transportation Safety Board (NTSB). Cooperation with the AAR occurs primarily in the areas of track/train interaction, track safety research, bearing defect detection, braking systems, grade crossings, train control, and hazardous materials (hazmat) transportation. The FRA has a contract with the AAR under which its wholly owned subsidary, Transportation Technology Center, Inc. (TTCI), manages FRA's Transportation Technology Center (TTC) at Pueblo, Colorado. The RPI arranges for its supplier-members to provide material and equipment for the Facility for Accelerated Service Testing (FAST) at the TTC, and also participates in the hazmat transportation projects. APTA, Amtrak, FTA, FAA, and the NTSB cooperate with the FRA on projects aimed at improving protection for railroad passengers. Representatives from the FRA serve on a number of TRB and industry committees to ensure that duplication of effort is avoided.

Human factors testing and simulations are carried out at FRA's other major facility: the Research and Locomotive Evaluator/Simulator (RALES) facility managed and operated by the Illinois Institute of Technology Research Institute (IITRI) in Chicago, Illinois for the FRA. RALES consists of a computer controlled, motion-based locomotive cab which is capable of training locomotive engineers and conducting research projects.

Over the last 5 years, FRA Research and Development has concentrated on applying research results from previous years to foster improved maintenance inspections and detection methods and techniques. FRA research supports the introducion of systems and devices that prevent track, equipment, or human failures which may cause derailments or collisions. The FRA's cooperative programs with industry reflect that approach. With a goal of complete elimination of



accidents, FRA research is also oriented toward ensuring that employees, passengers, and persons close to hazardous materials carried in trains are protected to the maximum extent possible – even in the event of an accident.

FRA research also supports safety rulemaking initiatives which are designed to ensure that the safety of new technologies and high-speed

passenger systems is maintained. During the period covered by this report, significant research results were achieved, through industry and academic outreach, in areas of automated systems safety validation and verification, collision avoidance and accident survivability, emergency preparedness, and right-of-way security.

During this reporting period, the FRA also undertook a new initiative, the Next Generation High-Speed Rail Program, as part of the Swift Rail Development Act of 1994. This program focuses on bringing innovative new technology to high-speed passenger rail industry. Key areas of research which will help enable higher speed operations are propulsion technologies, advanced control systems, and innovative grade crossing safety enhancements.

This report is organized into two major areas:

- Improving Safety
- Technology Advancement

Improving Safety consists of the following:

- Human Factors
- Rolling Stock
- Track and Structures
- Vehicle/Track Interaction
- Intelligent Track/Train Systems
- Highway-Rail Grade Crossing Safety
- Hazardous Material
- Train Occupant Safety
- High-Speed Rail Safety Assurance
- Research and Development Facilities and Test Equipment

Technology Advancement consists of the following:

- Next Generation High-speed Rail
- Track Evaluation, Improvement, and Maintenance
- Signaling and Communication Improvements
- Grade Crossing Risk Mitigation
- Non-Electric Locomotives
- Lightweight Brake Materials

For information on FRA Research and Development results prior to 1992, please reference *Improving Transportation Through Railroad Research*, 1988-1991, DOT/FRA/ORD-92/14, July 1992.