STATEMENT OF JOLENE M. MOLITORIS, ADMINISTRATOR
FEDERAL RAILROAD ADMINISTRATION
DEPARTMENT OF TRANSPORTATION
BEFORE THE
HOUSE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEE ON RAILROADS
AND THE
HOUSE COMMITTEE ON SCIENCE
SUBCOMMITTEE ON TECHNOLOGY

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Good afternoon, Madam Chairwomen and members of both the Subcommittee on Railroads and the Subcommittee on Technology. I am Federal Railroad Administrator Jolene Molitoris. With me today are Donald Itzkoff, Deputy Administrator, and Steven Ditmeyer, Director of our Office of Research and Development.

In my two recent appearances before the Railroads Subcommittee, I have described FRA's commitment to rail safety, and the achievements of our regulatory and enforcement program which incorporates a partnership approach with rail labor and management to address root causes of systemic safety issues. The rail passenger car equipment safety working group is meeting for two days here in Washington this week. Next week, FRA will convene the first meeting of the Railroad Safety Advisory Committee which will address our major regulatory challenges in a consensual context. In my previous testimony I also discussed FRA's successful programs and initiatives focused specifically on grade-crossing safety and trespass prevention, human factors, and equipment issues.

Today I will highlight FRA's emphasis on technology research, development, and deployment as a key to enhancing safety. Secretary of Transportation Federico Peña has strongly supported technology development as a major priority, and our FY1997 budget request reflects that commitment. FRA's FY 1997 budget proposal includes $52.5 million for rail technology research, development, and deployment, an increase of 9 percent over the FY1996 enacted level. For the Department of Transportation overall, support for technology development and related initiatives would receive over $1 billion in FY1997, underscoring the commitment of Secretary Peña and the Clinton Administration to support for transportation technology enhancement.

Advancing the implementation of Positive Train Control, or PTC, represents a core element of FRA's safety research and development program, and is a key objective of the agency's strategic plan. Put simply, PTC would use on-board computers, global positioning system (GPS) receivers on trains and maintenance equipment, and digital communications links between trains, maintenance equipment, and control centers to reduce significantly the probability of train collisions and overspeed accidents. PTC has attracted much attention recently in Congress and the media, but FRA has focused on the safety potential of this technology since the day I assumed office in 1993.

In a departure from the position of previous Administrations, which did not advance the recommendations of the National Transportation Safety Board that positive train separation or other train control technologies be implemented in a prescribed time frame, FRA has firmly addressed this challenge under my leadership with the strong support of Secretary Peña. In a report to Congress in 1994, FRA concluded that a cooperative approach with railroads, rail labor, and suppliers could "move PTC technology forward towards FRA's high-priority goal of

combining private and public sector efforts to foster deployment of contemporary PTC systems on high-risk rail corridors by the year 2000." In that report, entitled ***Railroad Communications and Train Control***, FRA fully examined the potential of PTC and outlined an ambitious action plan and time line to advance PTC deployment by the end of this century. A copy of that report is submitted for the record.

In my testimony, I will summarize FRA's findings in our 1994 report, and describe our achievements in meeting our action plan commitments to date. I also will outline FRA's proposed actions to advance PTC over the next 12 months, which are fully consistent with the time line FRA proposed in 1994. Based on our progress, and with the continued and accelerating commitment of railroads, rail labor and suppliers, I am confident that the potential for PTC we envisioned two years ago will fully be realized, enhancing safety dramatically.

FRA's 1994 "RAILROAD COMMUNICATIONS AND TRAIN CONTROL" REPORT

Beginning in 1982, the Association of American Railroads (AAR) and the Railway Association of Canada began investigating PTC-type systems and formulating industry standards. In the late 1980's, several US and Canadian railroads installed and operated test beds to evaluate the performance of various PTC system components and demonstrated them to interested observers. As part of the Clinton Administration's strong commitment to improving safety in all modes of transportation, and also in response to Congressional interest raised after several collisions in 1993, FRA prepared and published the ***Railroad Communications and Train Control*** report in 1994.

In that report, FRA described the potential of communication-based PTC, compared with existing train control systems. Half of the railroad route-miles in the United States today have no

signaling system in place. Trains are controlled on this "dark territory" by voice instructions, or fax transmissions of written instructions, from dispatchers to locomotive engineers. The other half of the railroad route-miles in the US are controlled by a variety of signal systems, all of which are based on fixed blocks and track circuits that are used for both train presence and broken rail detection. Of the half of the railroad route-miles that have signals in place, two-thirds are equipped with systems that enable dispatchers to remotely control switches and the signals that are co-located with the switches. Under 5 percent of the route-mileage of the US railroad system has systems in place where signal indications are shown in the locomotive cab or there is on-board enforcement of the signals, or both.

PTC functions in a different manner than existing signal systems. It is essentially an integrated railroad command, control, communications, and information system. PTC incorporates a control center that automatically receives position and velocity information from trains and other vehicles occupying track, and coordinates and controls their movement and speed through a control center computer. The heart of PTC is an automatic digital data link, capable of sending discretely addressed messages in both directions between a control center and a train or any other party on the track. The data link consists of dedicated radios that transmit digital data messages between locomotives, track vehicles, or wayside interface units and receivers located so that they can access the existing communications net. The data link will use existing UHF and VHF radio channels, along with microwave, wire lines, buried copper cable, or fiber optic cable. Every railroad will determine the optimum communications media for its data link on the basis of the system or systems it has in place, the performance it expects from a new system, and cost considerations. Other subsystems of PTC as it may be deployed include:

Position and speed system - makes use of the Global Positioning System (GPS) developed and deployed by the Department of Defense. GPS utilizes a constellation of 24 Navstar navigation satellites, and receivers are on each train and track vehicle.

On-board computer - automatically monitors and insures compliance with the movement authorities.

Integrated cab displays - display screens on each equipped locomotive show movement authorities -- including speed limits -- sent by the dispatcher in lieu of paper train orders, voice-transmitted track warrants, wayside signals, or traditional cab signals.

Wayside interface units - used to control and monitor the position of powered switches, monitor manual switches, and send data from wayside detectors, such as track integrity circuits, hot bearing detectors, dragging equipment detectors, and slide fences, back to the control center.

Operations control system - the brains of PTC, a sophisticated computer-aided dispatching system that will generate schedules, issue movement authorities and speed control instructions, determine compliance, monitor safety, optimize traffic flow, and implement dispatcher decisions.

Safety Benefits of PTC

FRA's 1994 report concluded that the various attributes of PTC would enable the improved management of train operations in a variety of ways and at lower cost than conventional train control systems. Implementing PTC would:

Ensure positive separation of trains so that trains do not collide or exceed speed restrictions by using an on-board computer to compare the location and speed of the train with a constantly-updated database of authorities and speed restrictions and would apply the brakes to stop or slow the train if the engineer made an error.

Maintain flexible block lengths that would permit trains to be more closely spaced without impairing safety, because each train's braking capacity is taken into account.

Improve the accuracy of train communications and reduce the potential for misunderstanding or miscopying by the direct transmission of digital messages from computers to display screens.

Maintain continuous communications between control centers and trains that, in turn,

can provide more **timely and complete information to train crews** and maintenance-of-way forces.

Enhance train management through train pacing, planning of meets and passes, and dispatching of trains from terminals. PTC could manage these efficiency gains with greater precision, improving the utilization and effectiveness of train crews and maintenance-of-way forces.

A more detailed description of PTC, how it works, and why it is safer, is included in FRA's 1994 report as submitted for the record.

1994 Benefit/Cost Analysis

In preparing for the 1994 report, the AAR, the Brotherhood of Railroad Signalmen. and the FRA collaborated on a study of the costs and benefits of accident prevention due to PTC. The analysis was based on a review of 116 accidents between January 1988 and August 1993, which all parties agreed could have been prevented by PTC. The 116 accidents included 35 derailments, 21 head-on collisions, 39 rear-end collisions, 15 side collisions, and 6 other accidents that, after examination of the individual accident report were judged to have been preventable by PTC. These accidents resulted in 420 injuries, 30 fatalities, and $70 million in reported property damage. The report presented an FRA estimate of PTC benefits (cost savings) of approximately $30 million annually from avoided accidents, as shown in Table 1.

The report also estimated the cost of universal PTC overlaid on existing signals at approximately $859 million. The cost of deploying PTC and removing existing signals was estimated at $1.137 billion. These estimates, which assume coverage for railroads in both the United States and Canada, are presented below in Table 2. The AAR provided these estimates to FRA for the 1994 report, and FRA believes that they represented a valid estimate of the cost of PTC at that time.

Table 1

ESTIMATED BENEFITS OF POSITIVE TRAIN CONTROL

ESTIMATE 1 (LOW) (AAR)		
Reported Property Damage	(5.67 years)	$70.0m
Additional Damage (56.25% of above)[27]		$39.4m
FELA[28]		$40.8m

		$150.2m ($26.6/yr)
ESTIMATE 2 (FRA)		
Reported Property Damage (5.67 years)		$70.0m
Additional Damage (56.25% of above)		$39.4m
Injuries		$ 8.4m
Fatalities		$78.0m

		$195.8m ($34.5m/yr)
ESTIMATE 3 (HIGH) (AAR)		
Reported Property Damage (5.67 years)		$70.0m
Additional Damage (100% of above)		$70.0m
Casualty Costs (Equal to ALL damages)		$140.0m

		$280.0m
Round up		$300.0m ($52.9m/yr)

[27] The damages currently reported to FRA do not include loss of lading, wreck clearance, or environmental cleanup. AAR surveyed its members and reports that, on average, these other costs constitute an additional 56.25 percent of the reported damages.

[28] AAR's estimate of casualty costs stated in terms of Federal Employers Liability Act recoveries.

Source: ***Railroad Communications and Train Control.*** Washington, DC: Federal Railroad Administration, 1994, p. 58.

Table 2

Estimated Investment Costs
Positive Train Control
Signal Control-Based Versus Communication-Based
Class I Railroads--United States and Canada

(Dollars in Millions)

SIGNAL CONTROL BASED			
SIGNAL CONTROL-BASED		$ 2,064	
COMMUNICATION BASED	**WARNING**	**ENFORCEMENT WITH SIGNALS**	**ENFORCEMENT WITHOUT SIGNALS**
FIELD COMMUNICATION-BASED	$ 1,196	$ 1,212	$ 1,490
CENTRAL COMMUNICATION-BASED	$ 843	$ 859	$ 1,137

Source: AAR, *Interim Report of Railroad Industry ATCS Strategic Planning Committee,* April 1994, as shown in ***Railroad Communications and Train Control,*** Washington, DC: Federal Railroad Administration, 1994, p. 64.

FRA's 1994 report also found that PTC "offers significant potential business benefits to railroads with pertinent needs not otherwise addressed through alternative technology. These include fuel savings, better utilization of track and equipment (such as work order reporting, locomotive health monitoring, and traffic control), reduced wear on track and equipment, on-board hot bearing detection, car/trip scheduling, more precise scheduling of employee deployment, reduced job stress for dispatchers, and better service for customers." As FRA noted, "All of these potential benefits offer possibilities for additional cost savings."

Based on this exhaustive review, and a comparison of the expected cost of PTC implementation with the level of anticipated safety benefits, FRA concluded that " a requirement

for universal PTC cannot be justified at the present time on accident avoidance alone." Even using optimistic assumptions about safety benefits as shown in Table 1, the substantial difference between these costs and benefits led FRA to conclude that *universal* implementation was not justified based on safety benefits only.

However, FRA concluded that "implementing PTC on major corridors is an important safety objective," because certain railroad lines carrying heavy passenger or hazardous materials traffic may experience greater risk with respect to the frequency and severity of accidents. Accordingly, FRA committed to a comprehensive plan of action to evaluate PTC implementation and identify principal rail corridors on which PTC is important and the safety benefits justify the cost.

FRA 1994 ACTION PLAN

In 1994, FRA also concluded that the prior work on PTC specifications "provide[s] a sound basis for further development," and "found significant potential benefits of PTC systems." FRA therefore established in its report a time line and coordinated plan of action to carry out a number of activities related to positive train control. FRA has aggressively carried out these activities and supported the early implementation of PTC in the railroad industry. Progress to date includes:

Advocacy for Interoperability

FRA is working closely with the AAR to ensure that AAR's open architecture approach for universal compatibility remains effective and that standards meet safety needs. We have maintained continuous liaison with AAR and the freight railroads to ensure that interoperability remains a primary objective of national train control development efforts. FRA has established a

partnership with AAR's Rail Operations Communications Systems Committee to oversee the systems being developed for freight railroad use and those being sponsored by FRA for high speed passenger use to attain maximum possible interoperability.

FRA contracted with Battelle Columbus Laboratory in 1994 for a study and report dealing with ***Analytical Methodology for Safety Validation of Computer Controlled Subsystems.*** A variety of methodologies were examined and reviewed and a new methodology was developed for validation of software for PTC-type systems in the US. This report has been circulated to industry where it is guiding the discussions regarding voluntary industry standards.

Assessment of Rail Corridors for PTC Applicability

Arrangements were made for the Volpe National Transportation Systems Center to carry out for FRA a risk assessment to determine which conventional rail corridors may warrant application of PTC technologies. Work started in 1995 and is expected to be completed this year on the development of a corridor risk model to evaluate the frequency and possible severity of train accidents on rail corridors with differing characteristics, such as traffic levels, traffic mixes, existing signal and train control systems, and other features. The first generation of the model is being designed to evaluate the potential benefits of upgrading the method of operation to include positive train control. When the model is completed this summer, analyses will be performed to determine whether certain rail corridors present a greater risk of collision, overspeed derailment, or other event preventable by use of PTC, and--if so--what quantifiable safety benefits from PTC would be expected.

Support of PTC Demonstrations

UP/BNSF: FRA has maintained close liaison with Union Pacific Railroad and Burlington

Northern Santa Fe Railway on their implementation of a positive train separation system (a precursor to PTC) test bed on heavily used freight and Amtrak lines in the States of Washington and Oregon. FRA has carried out a detailed review of how FRA safety regulations would apply to the PTC system. Using the results of the review, the railroads have submitted a request for waiver from applicable rules to permit testing. Under expedited handling procedures, FRA published the request for waiver in the Federal Register on February 16, and public comments are due by March 31, 1996. A copy of this Federal Register notice is submitted for the record.

Next Generation High-Speed Rail Program: FRA is sponsoring three pilot initiatives in cooperation with Amtrak, freight railroads, and State departments of transportation. These projects will demonstrate the cost-effectiveness and feasibility of new PTC technology as well as facilitate the implementation of high-speed passenger train service in three corridors: Seattle-Portland, Chicago-St. Louis, and Chicago-Detroit. For FY1977, FRA has requested $8 million, out of a total request of $28 million for the Next Generation High Speed Rail Program, to support these PTC initiatives. Progress includes:

Washington and Oregon: In August 1995, FRA granted $750,000 to the Washington State Department of Transportation to support the previously mentioned positive train separation system being developed by GE-Harris Railway Electronics for Union Pacific and Burlington Northern Santa Fe. The grant funds are being used to identify a migration path so that the positive train separation system ultimately supports high speed rail and to develop a computer model to assess the potential costs and benefits of using positive train separation and the effect of adding high-speed passenger traffic on the existing freight traffic flows on the Seattle - Portland corridor. The FY1996 appropriation for FRA's R&D Program provides $5 million specifically

for the implementation of the positive train separation system in the vicinity of Portland Union Station and to assess the reliability of the communications network in dense urban areas. While work on the positive train separation system has lagged behind schedule, managements of both railroads have assured me that they remain committed to the project. The initial hardware installations are now expected to take place during the third quarter of 1996.

Illinois: In September 1995, FRA entered into a cooperative agreement with and provided $1 million to the State of Illinois to demonstrate the AAR's Advanced Train Control System (ATCS), a version of PTC, on 150 miles of the Chicago - St. Louis corridor. Illinois will match with $2 million of state funds, and they have contracted with Arinc and Canac (the consulting arm of CN Rail) to serve as system integrators. The installation will occur on track owned by Southern Pacific between Springfield and Dwight. FRA's FY1996 appropriation also provides an additional $6 million for this project. Operations under ATCS are scheduled to begin 17 months after the award of the contract for hardware, which is expected to be let in the second half of 1996.

Michigan: FRA entered into a cooperative agreement with the State of Michigan in March, 1995, to provide $6 million to support the efforts of Amtrak and Harmon Industries in the implementation of an Incremental Train Control System (ITCS) which utilizes a digital data link and on-board location system and computer to augment the existing centralized traffic control system. Michigan DOT and Amtrak will install ITCS on the Amtrak-owned line between Kalamazoo and New Buffalo on the Chicago - Detroit corridor, and testing of hardware is scheduled to begin later this year. An additional $3 million is provided for this project in FRA's FY1996 appropriation. Hardware installation has already begun, and initial testing is scheduled

for September 1996.

Coordination with Other Federal Programs

As part of FRA's overall approach to facilitating development of PTC, FRA has meshed its PTC initiatives with related programs at the Department and elsewhere in the Government.

For example, FRA has extended its partnership with the Federal Highway Administration (FHWA) on highway-rail grade crossing safety to work together more closely in planning for interoperability between PTC technology and Intelligent Transportation Systems (ITS). I serve with the other DOT Modal Administrators on the Management Committee of the Department's ITS program, and other FRA staff serve on other ITS committees, including the Strategic Planning Group. FRA staff are working with FHWA staff in the preparation of the Highway-Rail Interface User Service specifications for ITS, and they are expected to be completed shortly.

Four grade crossing warning technologies referred to as Vehicle Proximity Warning Systems, which provide warning communications between trains and road vehicles, have been under evaluation at the Transportation Technology Center at Pueblo, Colorado. Performance limits, response to adverse conditions, and system performance and repeatability are being quantified. Depending on final results, consideration will be given to installation of one or more of the technologies on crossings on the PTC test corridors in Illinois, Michigan, and Washington. Other promising applications are expected as ITS technology matures.

In addition, FRA is working with other DOT and Department of Defense agencies to promote integration of defense technology into PTC systems, and in particular, to broaden coverage of the differential Global Positioning System in the Columbia River valley east of Portland to permit timely testing of advanced on-board location systems. FRA is also monitoring

the joint Federal Transit Administration-Defense Advanced Research Projects Agency Technology Reinvestment project to develop an advanced automatic train control system for rail transit systems.

ADVANCING PTC

Two years ago, FRA developed a comprehensive program and strategy to advance PTC implementation. These actions include undertaking a corridor risk analysis, participating in technology demonstrations, and other initiatives to establish the readiness and appropriate application of PTC technology. In our 1994 report, FRA committed that by FY1997, FRA would:

> Review conventional rail corridor risk analysis and, as appropriate, commence rulemaking to require PTC on identified categories of rail lines. Include development of generic performance criteria for improved train control systems applicable to high speed and conventional rail service. Complete rulemaking in FY 1998.

In keeping with that commitment, FRA is preparing for a comprehensive review of PTC deployment in 1997. This review and related decisions will be based on results of the initiatives I have already described along with the results of the related undertakings outlined below. Specifically, FRA will:

> **Accelerate safety assessments of likely PTC concepts.** In order to address concerns with how communication-based PTC systems will handle system failures, FRA will expand its PTC research to assess redundancies for handling system failures and other challenges to PTC such as rail defects and crossing hazards might present. This research will also assess the handling of failures in vital circuits.
>
> **Evaluate the safety and effectiveness of systems in the FRA PTC demonstrations.** While PTC systems and key components have been tested successfully, operating experience with the systems is limited. FRA will evaluate the safety performance of the systems in the three PTC demonstrations and their various components, and assess their overall fitness for further application. We also will perform an analysis of the benefits,

costs, and operating performance of these individual systems.

Review alternatives for development of control system software. Implementation of PTC requires extensive writing and testing of PTC software. FRA will work with suppliers and the AAR to evaluate who should develop this software and how its development should be financed.

Assess alternatives for financing PTC implementation. The magnitude of investment required for PTC implementation will be significant. According to AAR, about $1.1 billion is required to implement PTC on all railroads in the United States and Canada, about 20 percent of one year's capital expenditures for the railroad industry as a whole. FRA R&D and Safety staffs will undertake an assessment of options for funding PTC investments, with particular attention to how commuter railroads might fund their improvements. In response to a letter I sent out last month concurrent with the issuance of Emergency Order 20, FRA expects shortly to receive estimates and program plans for PTC or automatic train control implementation from commuter railroads, including an explanation of potential financing requirements. FRA will incorporate this input from commuter agencies in its overall assessment of PTC implementation issues.

Update benefit-cost analysis: The cost of computers, communication equipment, and other PTC components has declined significantly in just the past two years, while freight and intermodal traffic has grown, causing congestion on some lines. FRA will take a new look at the benefits of PTC, along with potentially lower or revised implementation costs. Under our cooperative agreement with the State of Washington, FRA will gain access to an analytical model that will help us evaluate the effectiveness of PTC in optimizing capacity on existing rail lines, avoiding expensive investments in new main line trackage and other facilities.

Develop regulatory standards for PTC systems: During 1997 and 1998, as committed in the 1994 report, FRA will develop regulations expressly authorizing the use of communication-based train control systems. We are already at work determining the critical functions that a communication-based train control system must perform if it is used as the primary method of controlling train operations. Putting performance standards in place, including criteria for validating the safety of computer-based control systems, will ensure that concern over regulatory approvals is not be viewed as detriment to sound investments. This action will also reduce the technical risk associated with finalizing interoperability requirements, a task appropriately undertaken in the private sector. Work accomplished with the three PTC demonstration programs provides an important foundation for this regulatory effort, as well as guidance for initial efforts to achieve interoperability.

FRA is committed to bringing the results of these efforts together in FY1997. Some caveats must be noted, however. FRA is concerned that delays of up to 12 months in the UP-BNSF pilot project in the Pacific Northwest may adversely affect our ability to determine final costs and service reliability of first-generation safety systems using communication-based technology. FRA continues to encourage UP and BNSF to accelerate their current timetable for an initial demonstration, which is not scheduled to be completed until the end of 1997, to make up some of the delay to date. Accelerated planning with respect to migration to a vital PTC system would also aid FRA's evaluation, as well as hasten the active consideration by other railroads of the business benefits of these investments. Obtaining early results from grant-funded demonstrations in Michigan and Illinois will also be important to evaluating the technology options that can be expected to be elected as PTC deployment begins on a larger scale.

Commuter railroads need to evaluate capacity and capital investment factors pertinent to their operations, yielding further data for a national evaluation. We have asked for that information from each commuter authority, as part of our safety outreach process in conjunction with Emergency Order 20.

In FY 1997, FRA will evaluate the possibility of deploying PTC on principal rail lines of the United States. These are the lines that are used for intercity passenger service, for growing commuter rail service, and for line-haul carriage of the largest share of the Nation's goods. Increasingly, flexible use of freight locomotives, joint trackage rights arrangements among freight railroads, joint commuter/freight operations, shared terminal facilities, and other coordinations of rail service make it critical that all road locomotives be equipped with

interoperable PTC equipment in order to realize maximum benefits from any discrete investment on a line segment. Coordinating the initiatives of freight and passenger railroads will be essential to achieving the "critical mass" that can lead to the safety benefits we all so eagerly seek.

Congress can help by continuing to fund investments requested under the President's Budget and by signaling a continued commitment to viable public/private partnerships that can propel the deployment of interoperable PTC at the earliest possible date. Consistent with the action plan and time line FRA proposed nearly two years ago, in 1997 FRA intends to consider regulatory standards requiring PTC on identified categories of railroad lines. I expect that the data we will derive from our risk analysis, along with all the information gained from the test bed deployments to date, will guide us, in consultation with our railroad, labor, and supplier partners, in these important safety decisions. FRA intends to lead this partnership process to ensure that such matters as nationwide interoperability and supplier competition are taken into consideration.

CONCLUSION

Within the Department of Transportation, every Modal Administration has projects underway to examine how new information technologies can be used to increase the safety, efficiency, and capacity of our Nation's transportation system. The Intelligent Transportation Systems program represents a multimodal approach aimed at improving the throughput and safety of highways and transit systems.

I am encouraged that the railroad industry, including both freight and passenger operators, is continuing to work toward the establishment of modern digital communications capabilities both on board trains and between trains, wayside equipment, and control centers. A major public policy challenge will be to ensure that these communications systems and other interactive

elements, including PTC, Advanced Train Management, electronically controlled brakes, sensors on vehicles, sensors on tracks, and sensors at grade crossings, form a network in which there is compatibility and connectivity among all the elements. The promise of such an *Intelligent Railroad System* will provide the United States with a railroad network that is safer, has greater capacity, is more reliable, and can accommodate higher speeds and a wider range of operations.

PTC offers great potential for the Nation's railroads. The concern today, however, is the extent to which PTC is ready for implementation in revenue service, and how that implementation should be phased. Core technical issues which remain to be addressed include GPS and differential GPS accuracies, availability and capability of radio frequencies, and software verification and validation. Through support for demonstration and testing of PTC systems and subsystems, and research and development on key PTC issues, FRA is committed to working with our partners to drive down costs and eliminate technical obstacles to implementation. FRA is also committed to assessing the safety potential of PTC in corridors where it is appropriate, and to developing regulatory standards to guide PTC implementation at the earliest possible date.

Madam Chairwomen, I want to assure you that the Federal Railroad Administration is committed to supporting this process to the fullest extent of our resources and mandate. In addition, we will continue to carry out our efforts with the railroads, the railroad supply industry, the AAR, and rail labor to develop other technologies dealing with equipment, track, and human factors that could also improve the safety of our Nation's railroads. These related research and development activities are critically important to FRA's safety mission. Excerpts from FRA's 1997 budget justification for proposed railroad research and development programs, which

highlight the extent of our commitment to enhancing safety through technology, are appended to my testimony.

I thank you for the opportunity to testify before you today. I would be pleased to answer any questions you may have.

FEDERAL RAILROAD ADMINISTRATION

RAILROAD RESEARCH AND DEVELOPMENT PROGRAM

NEXT GENERATION HIGH-SPEED RAIL PROGRAM

EXCERPTS FROM THE
FY1997 CONGRESSIONAL BUDGET SUBMISSION

OFFICE OF RESEARCH AND DEVELOPMENT

Safety is the major priority for the FRA's conventional freight and passenger R&D program, both to support the FRA Office of Safety mission and to directly work with the industry to identify and implement safety improvements. The other primary goals of the FRA Office of Research and Development (OR&D) are to improve the productivity of the railroad industry and to facilitate the introduction of high-speed ground transportation in the United States. R&D program planning is designed to anticipate and, where possible, prevent the development of potential safety hazards. The R&D program addresses issues in rolling stock, human factors interactions, hazardous materials transport, track, signals and control systems, vehicle/track interaction, and inspection/detection technologies for conventional railroads and high-speed ground passenger transportation. Also included are the R&D Facilities and R&D Administration.

The R&D program develops information needed to support FRA's safety mission and to improve rail transportation through the use of advancements in technology for both freight and passenger rail systems. This is accomplished by the development and revision of safety guidelines, standards, and regulations. Continuing R&D in these areas is essential to provide information to maintain up-to-date safety rules as new equipment, materials, procedures and methods are introduced in the rapidly changing railroad environment. Other R&D programs result in the voluntary adoption of the research results by the private sector organizations in the railroad industry, and implementation of research findings through industry-prescribed maintenance and operating procedures.

An effective safety research program is essential to fulfill the objectives of the National Science and Technology Council (NSTC), the NSTC's Interagency Coordinating Committee on Transportation Research and Development, the Department of Transportation's Strategic Plan, the FRA's Strategic Plan, recommendations of the National Transportation Safety Board (NTSB), and the FRA Office of Safety's railroad transportation safety assurance and regulatory responsibilities.

EQUIPMENT, OPERATIONS, AND HAZARDOUS MATERIALS (IR-1)

This program is looking at new technologies to ensure a safe, environmentally sound rail transportation system and to improve the efficiency of U.S. rail transportation. To accomplish this, FRA is investigating the use of new materials for rail vehicles and new diagnostic techniques for vehicles and components. FRA is also examining operating procedures and human performance to identify potential safety improvements. The primary goals and objectives which have been established under this program address and complement the major initiatives established by the FRA Administrator in supporting both the Agency and the Department mission of providing the nation with safe, technologically advanced, efficient, and effective rail transportation.

In 1994, over 40 percent of the reportable rail accidents were due to equipment failures or human factors. The resulting costs of these accidents were over $75 million. In some of these accidents, tank cars carrying hazardous materials were involved, with more than 160 tank cars damaged and 14 releases of hazardous materials. This program will include evaluation of the causes of these accidents and the safety of the equipment and operating practices, identifying where improvements can and should be made.

The rail industry is continually introducing new, higher capacity vehicles with lower tare weights, longer and faster train consists, more powerful locomotives, and innovative configurations and concepts to address the growing demand for increased traffic and reduced operating costs. The Equipment, Operations, and Hazardous Materials program is designed to evaluate the safety implications of these industry initiatives.

Under the *Equipment and Components* subprogram, funding in FY 1997 is being requested to improve the safety, reliability, and overall performance characteristics of passenger vehicles, freight cars and locomotives. The major output for passenger vehicles in FY 1997 will be the dynamic performance specification for conventional vehicles. The initial research results on evaluating improved roller bearing wayside inspection techniques will be made available. The evaluation results on the development and implementation of new Nondestructive Evaluation (NDE) inspection and detection methods will be made available for the establishment of wheel removal criteria limits based on residual stress levels and crack initiation and propagation parameters. Continued evaluation of the securement of containers on flat cars should confirm fail-safe measures to prevent the reoccurrence of accidents such as that in May 1994 at Smithfield, NC. The research findings and demonstration testing for advanced electric brake systems, applicable for long integral trains, will be completed and made available to the industry for potential drafting of final specifications and testing procedures.

This effort is in support of the Department's vision and R&D priorities defined under the NSTC's goal to **Promote Long-term Economic Growth that Creates Jobs.** The major priority addressed under this request is the development of technologies that improve the efficiency of U.S. transportation while improving safety and environmental quality. Specific priorities include improved system assessment tools; and advanced materials, monitoring and inspection for improved physical equipment and infrastructure.

Under the *Operating Practices* subprogram, funding is being requested to focus research on identifying root causes for repetitive human errors and developing effective countermeasures. All projects in this subprogram are designed to promote safe and secure transportation. Approximately one-third of all railroad accidents reported each year are caused by human error. Reducing accidents reduces operating costs which leads to increased productivity and an enhanced competitive position for the railroads. This is directly supportive of the safety aspects of the NSTC goal to **Promote Long-term Economic Growth that Creates Jobs.**

The onset of fatigue leads to the degradation of performance of all workers, and the potential for human error increases. Four railroad occupational areas are of particular concern because human error in task performance can and does lead to catastrophic train accidents. Such accidents can, and do, involve release of hazardous materials which damage the environment, human casualties and high costs for lost lading, damaged equipment and recovery. R&D on the effects of stress and fatigue on locomotive engineer performance, underway since 1991, is expected to focus on mitigation strategies in 1997. Research on workload, stress and fatigue issues affecting train dispatchers and the practices of yard workers will continue in FY 1997. High-speed train operations may have unique influences upon the operator's ability to remain alert. Work focused on these issues will also continue in FY 1997.

Operation Lifesaver activities to raise public awareness about the hazards for motorists, pedestrians and trespassers that exist at highway-railroad grade crossings, and in the vicinity of all train operations, is a very cost-effective safety program. Continued support for this program is essential. The vast majority of injuries to railroad employees occur in switching yards and terminal areas. An analysis of the accident data related to past injuries is expected to yield several areas of activity for further investigation. This project, begun in 1995, will be conducted in phases.

Hardware and software to be placed in locomotive cabs to implement the Advanced Train Control System is expected to be available in FY 1996. FRA plans to evaluate the human factors safety implications of the design, placement and function of this equipment. As train dispatching functions are consolidated and the technology for dispatching becomes more sophisticated, evaluation of the adequacy of railroad training programs for dispatchers becomes more critical. This evaluation began in 1995, and is expected to continue into 1999.

Under the *Hazardous Materials* subprogram, funding is being requested for major improvements in tank car safety to continue the past efforts to minimize the incident rate of leaks, spills, damage to equipment and the environment; and to reduce the number of injuries and fatalities to operating crew members and the public in general. The whole issue of tank car structural integrity will continue to be a high priority. This includes investigation into critical flaw size, damage assessment/tolerance evaluation, and stub sill cracking. Evaluation of new materials and procedures for manufacturing will continue, as will development of acceptance procedures for new tank car designs.

The other main thrust is to develop acceptable methods for evaluating the structural integrity of tank cars during routine shop and prescribed scheduled periodic inspections, including new techniques for nondestructively evaluating welds in jacketed and/or lined tank cars. The development and validation of non-destructive methods and techniques for inspecting jacketed and lined tank cars will continue into FY 1997. Another R&D project will use damage tolerance for service termination, the setting of scheduled periodic inspection of tank cars, and quality of repairs for continued tank car service. This is intended to maintain the level of container integrity for hazardous materials containers in particular.

This subprogram supports the NSTC goal to **Promote Long-term Economic Growth that Creates Jobs** by improving the efficiency of U.S. transportation, the safety of hazardous materials transportation, and environmental quality. By improving the tank car structural integrity, there will be a reduction in the number of releases of hazardous materials in accidents. This directly relates to the NSTC goal to **Improve Environmental Quality**.

TRACK, STRUCTURES, & TRAIN CONTROL (IR-2)

Nearly every year, train accidents are most numerous in the reported category of track and signal defects. Property losses and remedial expense due to such accidents together approach $50 million per year, and sometimes cost lives of train crew, passengers, motorists, or public bystanders. In DOT's recently enunciated set of Strategic Goals, the central one is to "promote safe and secure transportation," and FRA has had a long-standing statutory responsibility in that regard under CFR 49, part 200 et seq. In addition, the National Transportation Safety Board (NTSB) has recommended that FRA develop improved means for assuring the safety of railway track. Thus, the Track, Structures, & Train Control (TS&TC) program responds to these thrusts by means of a multifaceted research program whose concern encompasses track and signal components as well as their dynamic interactions with rolling stock. FRA's objective is to promote safety by improving the structural and operational performance of the track components and signal elements that enable the transport of passengers and freight with world-class economic efficiency.

FRA's TS&TC R&D program directly matches several of the five assessment priority measures developed by the NSTC's Interagency Coordinating Committee on Transportation R&D. The TS&TC program has an obvious benefit to public safety, and also benefits both the economy and environmental sustainability via technology improvements that reduce costs in railroad operations. FRA's program thus helps to make a highly fuel-efficient transportation mode even more so.

The Coordinating Committee on Transportation R&D noted the importance of improving life-cycle performance of transportation infrastructure. One of the Committee's Strategic Goals linked the efficiency of this infrastructure to improvements in means for maintenance, rehabilitation, and renewal. The TS&TC program's leading "Major Activity," *Track and Components*, is directly oriented toward this concern via research into rail integrity, rail fastening, and rail wear. Closely related is the second major activity, *Inspection-Detection*, since this activity supports data flow to the information infrastructure that enables making logistics decisions regarding track infrastructure status, with resultant implications for safety, operational efficiency, and capital recovery.

Another of the Committee's Strategic Goals deals with vehicle performance, with implications regarding both energy efficiency and safety. The TS&TC program's third major activity, *Track-Train Interaction*, directly addresses this area by aiming to reduce undesirable impact energies and vibrations that waste drive power and can raise the risk of derailment.

The Committee's Strategic Goals place emphasis on the concept of an information infrastructure (potentially part of the broader notion of a national "Information Highway") that, for the railway mode, can allow improvements in monitoring locations of trains, in management of traffic separation, and in providing warning at grade crossings. The TS&TC program's fourth major activity, *Signals, Train Control, Communications, and Electrification*, provides the mechanism to address the onslaught of technological advances in these areas and their impact upon the currency or obsolescence of existing FRA regulations.

A notable area of technological progress arising from the TS&TC research program is exemplified by work at the Facility for Accelerated Service Testing (FAST), which is located at DOT's Transportation Technology Center (TTC) near Pueblo, Colorado. FAST is a highly versatile real-world test bed upon which approximately one-third of the TS&TC projects are being accomplished, many via multi-year efforts. The cooperative FAST program is supported by the AAR, individual railroads, and members of the railway supply industry. Major research initiatives are being undertaken to evaluate the performance of track components and new rolling-stock designs under the rigors of heavy axle loads (HAL), but in a greatly compressed time period. Extensive tests comparing older freight cars (33-ton standard axle load) to HAL cars (39-ton load per axle) have revealed how rail and track components can deteriorate as typical coal-car load capacities evolve from the earlier 100-ton average, through the now more frequent 110-ton average, toward a possible future 125-ton standard. The HAL tests cover a broad range of track-related concerns and will yield increased knowledge regarding rail fatigue (crack propagation), advances in areas such as railhead shape maintenance (grinding schedules), turnout (track switch) design (especially frogs), subgrade preparation (soil & drainage), and tie life (baseplate cutting). These results will contribute to better economic efficiency of the railroad fixed infrastructure and to increased safety.

Outcomes of TS&TC research have become embodied in a variety of implementations. Based on new knowledge gained at FAST regarding defect growth in rails, and upon analytical studies conducted by the Volpe National Transportation Systems Center, appropriate revisit frequency for rail testing can now be established. Prototype hardware has been developed (and proof-tested at DOT's Pueblo TTC) for in-situ measurement of the amount of resistance that a track can present to dynamic load-induced lateral buckling forces that are dramatically worsened by summer-season expansion of continuous welded rail. A Track Loading Vehicle has been employed for dynamic measurement of gauge widening, flange climb derailment dynamics, and a variety of other wheel-rail interaction issues. Draft specifications for track geometry have been developed to prevent modes of derailment that result in a train leaving the track without having the occurrence of mechanical (structural) failure of the vehicle or track as a precipitating cause.

Some significant upcoming events in various major activities of the TS&TC program are as follows: Special head-hardened rail with unique profile grinding patterns will be tested under 125-ton HAL cars with improved freight car trucks. The FRA-developed Gauge Restraint Measurement System will be deployed to various mainline and short-line railroads to identify high-deflection danger spots that may lead to wide-gauge derailments, and to provide information for economic tie-replacement strategies. Research results are announced in various forums including the FRA Office of R&D, the European Rail Research Institute, and the National Research Council of Canada jointly sponsored fourth quadrennial Wheel-Rail Conference at the University of British Columbia in Vancouver BC, Canada.

Examples of work that will be started with requested funds includes the following: developing a fuller understanding of causal factors in long-term rail fatigue failure processes; improving the methods for assessing rail integrity and mitigating defect occurrences; track buckling tests of track laid with continuous welded rail upon concrete ties; evaluation of advanced braking techniques (i.e., via radio control) on heavy-load high-speed unit-train freight consists; determination of track-geometry limits required for high-speed passenger-train operation; and tests and evaluation of new signal designs and other components of advanced train control systems.

An important initiative provides for an interlocked set of research projects to obtain broader theoretical understanding of the multiple factors contributing to derailments, together with on-track tests at the Pueblo test track of derailment scenarios under static and near-critical dynamic conditions.

In summary, the Track, Structures, and Train Control program provides a broad-spectrum approach to the aim of increasing safety and economic efficiency of America's railroads. FRA's multi-year programs have led to significant technological advances and have contributed directly to increased safety for railroad employees, the traveling public, and communities along rail lines.

SAFETY OF HIGH-SPEED GROUND TRANSPORTATION (IR-3)

The successful deployment of innovative high-speed ground transportation systems poses a wide variety of safety issues. The objective of this program is to utilize a system-safety approach to address the issues associated with the deployment of these innovative systems. Activities under this program include monitoring the technologies which are being proposed, planned, or deployed so that FRA can take appropriate and timely regulatory action to assure the public of safe operations while assuring system developers that there will not be unwarranted delay or interference to the implementation of new systems and technologies which can provide enhanced transportation to the public.

In FY 1997, the *High-Speed Rail* subprogram will evaluate the linking of High-Speed Positive Train Control with a grade crossing which protects highway traffic with ITS-based technology. Assessments will be conducted of the safety of the advanced prime mover and transmission technologies under development in the Next Generation High-Speed Rail Technology Development Program. The evaluation of foreign technologies proposed for application in U.S. service will continue, as will a major project assessing the safety of prototype grade crossing protection and train control systems. High-speed track standards and track maintenance practices will be studied along with mechanical component and vehicle performance, and advanced test support equipment will be acquired to implement these advances for testing of high-speed trainsets at the Transportation Technology Center in Pueblo, CO.

High-speed rail operation in existing corridors can be accomplished rapidly with existing technology, but the risk levels for both the traveling and wayside public increase substantially. Strategic planning for the implementation of such systems requires comprehensive knowledge and assessment of system conditions, performance, and operations. A major issue which must be addressed is protection of highway grade crossings which cannot be removed from high-speed corridors. In FY 1997, funding is requested to address issues related to sight distance and train visibility for high-speed train operations and to determine if a multi-level, time-based warning system using Positive Train Separation, Advanced Train Control Systems, and Global Positioning Systems can be established. Driver behavior plus perceived audibility and credibility of warning devices must be assessed when grade crossings must be physically closed for periods approaching two minutes to assure the safety of both highway and rail crossing users. Funding in FY 1997 will continue the work initiated in FY 1996. Movable barriers to physically close such crossings are under development and test. System safety assessments of these systems will be conducted in FY 1997.

A second major issue is the increased risk level presented by the operation of freight traffic on the same right-of-way as high-speed passenger trains, including risks of collision and creation of obstructions in the path of high-speed trains. Existing train control technologies to address these problems present high acquisition and installation costs. Innovative train control systems which utilize space-based navigation systems and advanced digital radio techniques are becoming available and are being deployed in demonstration systems. In FY 1997, FRA will monitor and evaluate the ability of these approaches to control high-speed passenger traffic.

The *Maglev Systems* subprogram will fund partnerships with DOD and NASA, as well as continue other research, to bring enabling technologies for maglev vehicles and guideways to a promising state for development. The potential of magnetic levitation technology to deliver airline-competitive travel times with a ground-based mode will generate continuing interest in such systems. FRA anticipates that one or more demonstration systems may be planned or constructed in the not distant future. Continued limited funding is proposed in the SHSGT program to assure that technical development is maintained in programs for guideway element cost reduction, establishment of performance and safety limits, and high-speed aerodynamic performance issues.

A third subprogram is *Environmental Issues.* Specific projects include noise evaluation and the effects of electromagnetic fields for high-speed rail, maglev and conventional rail.

R&D FACILITIES (IR-5)

Funding is requested to update the facilities at the FRA's Transportation Technology Center near Pueblo, Colorado. This world-class facility is used by the FRA and the railroad industry to conduct research and testing of equipment, components, hazardous material tank cars, track structures, signals, grade crossing protection, and many other items in a carefully controlled revenue-like setting without the potential for causing disruptions in revenue service. The facility is the venue of numerous cost-shared R&D partnerships among the AAR, individual railroads, the rail transit industry, the FRA, the Federal Highway Administration, the Federal Transit Administration, and elements of other Government departments.

R&D ADMINISTRATION IR-6

Funding is required for the R&D staff and related support costs.

Exhibit IIIC

FEDERAL RAILROAD ADMINISTRATION
RESEARCH, DEVELOPMENT AND TECHNOLOGY ACTIVITIES

Appropriation: Railroad Research & Development

(Dollars in Thousands)

Budget Activity/Program		FY 1995 Enacted	FY 1996 Enacted	FY 1997 Request
IR1	**Equipment, Operations, and Hazardous Materials**			
a.	Equipment & Components	1,850	1,850	2,225
b.	Operating Practices	2,563	2,710	2,595
c.	Hazardous Materials	1,000	1,000	1,000
		5,413	**5,560**	**5,820**
IR2	**Track, Structures, & Train Control**			
a.	Track & Components	2,885	2,785	3,335
b.	Inspection-Detection	2,785	2,400	2,200
c.	Track-Train Interact	1,000	850	2,050
d.	Signal & Train Cntrl	2,495	1,047	1,382
		9,165	**7,082**	**8,967**
IR3	**Safety of HSGT**			
a.	HSR Systems	2,500	9,178	5,569
b.	Environmental	400	200	600
c.	Maglev Systems	400	0	1,000
		3,300	**9,378**	**7,169**
IR5	**R&D Facilities**			
a.	Facilities Restoration	200	400	420
		200	**400**	**420**
IR6	**R&D Administration**	**2,121**	**1,695**	**2,189**
	Total	**20,199**	**24,115**	**24,565**

Federal Railroad Administration
Research, Development and Technology Activities

Program Title: Next Generation High-Speed Rail (HSR)
Budget Item no.: IR-4
Amount Requested for FY 1997: $27,946,000

GOALS:
Develop, demonstrate, and validate cost-effective high-speed (125-150 mph) passenger rail technology to operate on existing infrastructure in the United States; reduce upgrade costs for high speed from about $10 million to $2-3 million per mile; and by year 2000 make proven technologies and methods available to States for HSR implementation.

MAJOR ACTIVITIES AND ANTICIPATED FY 1996 ACCOMPLISHMENTS:
Activity areas include: (1) advanced train control systems to maximize safety and track capacity; (2) safe, reliable non-electric locomotives to quickly reach and operate at up to 150 mph; (3) mitigation of grade crossing hazards to limit risk imposed by high-speed service; and (4) planning tools to assist States in optimizing the design and economic performance of high-speed ground transportation systems.

High-Speed Positive Train Control
- Incremental Train Control System (ITCS) in Chicago-Detroit corridor; and Advanced Train Control System (ATCS) in Chicago-St. Louis corridor.
- Migration path to high speed for Burlington Northern-Santa Fe/Union Pacific Positive Train Separation (PTS) system.
- Address communications integrity and equipment interoperability issues.

Non-Electric Locomotive
- Determine operating and maintenance characteristics of new design locomotives.
- Continue flywheel energy storage technology development.
- Continue upgrade of high-speed test track at the Transportation Technology Center.
- Test active locomotive noise control.

Grade Crossing Hazards and Innovative Technology
- Develop in-cab warning systems and techniques to minimize hazards.
- Continue TRB Innovations Deserving Exploratory Analysis (IDEA) program applying Intelligent Transportation Systems (ITS) to Grade Crossings.
- Integrate grade crossing monitors, train control and other protective systems.
- Mitigate poor ride quality and reduce high track-train forces at chronic problem track locations.

Planning Technology
- Update, integrate user-friendly HSR operational and economic performance forecasting models for State planning use.

KEY FY 1997 PRODUCTS AND MILESTONES
- Validate feasibility of new positive train control technology.
- Demonstrate operability of flywheel energy storage systems.
- Evaluate performance of advanced non-electric locomotives.

FY 1997 PROGRAM REQUEST
New initiatives are to:
- Initiate demonstration of communications-based train control in high density freight and passenger corridor.
- Initiate Track and Structures as a major program focus area to address capacity and ride quality improvement issues.

Ongoing projects will:
- Sustain progress toward development, demonstration, and validation of key technology for year 2000 target of making cost effective HSR technology commercially available.

FY 1997 REQUEST HIGHLIGHTS

Budget Activity/Project	FY 1996	FY 1997	Difference
	(Dollars in Thousands)		
Technology Development			
- Positive Train Control	9,000	8,000	-1,000
- Non-Electric Locomotive	9,000	9,000	0
- Grade Crossing & Innovative Technology	4,500	6,000	1,500
- Track and Structures Technologies	0	3,000	3,000
- Planning Technology	1,250	1,518	268
Subtotal, Technology Development	**23,750**	**27,518**	**3,768**
Administration	401	428	27
TOTAL, HSR	**24,151**	**27,946**	**3,795**

TECHNOLOGY DEVELOPMENT **$27,518,000**

HIGH-SPEED POSITIVE TRAIN CONTROL SYSTEMS **($8,000,000)**

The request for this activity is to continue the high priority development and demonstration of radio-based train control systems that can enhance the safety of high-speed systems and lower the capital costs associated with the development of HSGT systems over the entire length of corridors operating in dense urban areas and on lines with intense freight traffic. This activity consists of the following two projects:

Train Control In Dense Urban Areas [$5,000,000]

This project continues and expands the demonstration activity initiated in FY 1995 of radio-based train control systems, which focused on initial implementation of the basic technologies of these systems in benign environments: rural areas with limited rail traffic. This effort moves to validate such systems in urban environments dense with both rail traffic and radio communications traffic. Satisfactory operation of these new systems in such areas is mandatory since acceptable passenger service quality will be judged on total trip time. Minutes of delay in the origin or destination city environs can seldom be recovered and reduce total service quality.

Train Control Using Flexible Block Operation [$3,000,000]

Existing rail routes which are attractive for high-speed passenger service often already carry heavy freight traffic and are at or near capacity. Addition of high-speed passenger

operations will be possible only if train control systems are implemented which increase line capacity by relieving the constraints imposed by "fixed-block" signaling systems which are hardwired to physically divided sections of track. This project is to implement the ultimate objective of radio-based train control: high-speed flexible block operations where a central control center establishes the track zones for each train as needed only for safety and proper train separation, utilizing the automatic location system, train-to-wayside digital radio network, and computer processor aboard each locomotive to assure safe train operation and safe separation distances from other trains nearby.

HIGH-SPEED NON-ELECTRIC LOCOMOTIVE **($9,000,000)**

This activity continues efforts begun in FY 1995 to facilitate development of domestically-produced high-speed high-acceleration locomotives which do not require electric power from wayside supplies via costly catenary systems. This activity has two major projects:

Prototype Non-Electric High-Speed Locomotive [$6,000,000]

This effort will incorporate the best of the technologies under development and test in the Next Generation Program and incorporate them into a prototype locomotive. Major candidates for project activity include continuing and expanding the small fleet operations and maintenance demonstration for upgraded turbine locomotives begun with the State of New York in FY 1995, as well as beginning locomotive-mounted testing and demonstration of the hybrid flywheel-turbine Advanced Locomotive Propulsion System initiated as a joint ARPA-FRA project with the University of Texas and several industry partners in FY 1995. The product of these efforts will be a prototype operational locomotive for evaluation on the basis of maximum speed, acceleration, fuel economy, and track and locomotive maintenance requirements.

Upgrade of TTC Track for High-Speed Testing [$3,000,000]

This project continues the development begun in FY 1995 of high-speed test facilities at the Transportation Technology Center (TTC) at Pueblo, CO. The existing high-speed, electrified test track at TTC is undergoing total rehabilitation to provide safe testing at sustained speeds in excess of 150 mph. The rehabilitated facility will support testing of advanced high-speed locomotives and trainsets for developing high-speed corridors nationwide as well as for the Northeast Corridor; innovative grade crossing safety systems, and other promising new technologies identified under the HSR technology development program. The testing capability provided by the facility at TTC will be a unique national asset which will permit proof testing of high-speed systems without placing operating passenger or freight railroad lines, or the nearby wayside public, at risk or inconvenience. The product of this effort will be the completed test track ready for equipment testing.

GRADE CROSSING HAZARDS AND INNOVATIVE TECHNOLOGY **($6,000,000)**

Request of $6 million reflects an increase of $1.5 million above the FY 1996 enacted level. Grade crossings continue to be a major issue in the implementation of high-speed rail service on existing infrastructure and the increased funding will be targeted at arriving at a comprehensive methodology by which states and their partners can successfully address this issue. FRA will continue to build on the defense conversion/technology development work begun in FY 1995 by focusing on intensively testing, evaluating, and demonstrating the most promising new concepts and components selected from the initial evaluations conducted in FY 1995. Efforts will be fully coordinated and a joint solicitation will continue to be conducted with the Intelligent Transportation Systems (ITS) IDEA Program to achieve the widest possible opportunity for all segments of U.S. industry, academia, and Government development organizations to participate in the program.

Mitigating Grade Crossing Hazards [$4,000,000]

This project continues the Department's increased emphasis on promoting grade crossing safety by promoting a comprehensive approach to crossing hazards on a total corridor basis. This funding will complete a demonstration program which evaluates multiple solutions and provides a methodology to states and their partners. It will explore further opportunities for interlinking railroad signal systems, grade crossing protection, automatic train control systems (ATCS), and highway applications of Intelligent Transportation Systems (formerly IVHS.) This effort will take full advantage of the new information on train location and new communications options developed to implement train control systems to accomplish advanced vehicle warning, to operate more effective protection systems at crossings, and to further the development of forgiving barrier systems which may be necessary at highway crossings which must remain on high-speed lines.

Low Cost, Innovative Technologies [$2,000,000]

This project will continue the successful Broad Agency Announcement approach to solicit a wide range of technology projects from the entire spectrum of American industry, academia, and individuals. This program element enables the program to benefit from proposed technologies from all persons with candidate technologies, without requiring that the proposed be directly involved with a major project on a specific geographic corridor.

TRACK AND STRUCTURES TECHNOLOGIES **($3,000,000)**

This is a new program activity and funding will be used to seek out and demonstrate advanced, more economical technologies to resolve corridor capacity constraints and bottlenecks through more cost-effective track and structures technologies. Activities in this focus area were previously included in the Low-Cost Innovative Technology area.

idor capacity limits will otherwise preclude meaningful ls of high-speed rail service on corridors which already carry heavy freight traffic and conventional passenger and commuter services. Methods for increasing corridor capacity must be accomplished with track and structures components which not only provide acceptable ride quality for high-speed trains, but also withstand the extreme duress of heavy freight traffic on a continuing, economical sustained basis. Approaches which will be examined include lower cost designs and installation methods for high-speed switches and crossovers; improved methods for upgrading existing track structures to higher performance levels; and more cost-effective methods of track construction on either existing routes or to replace track on pre-existing parallel rights-of-way which no longer have track installed. The goal of the new focus area is to provide states and their partners with validated, cost-effective technology to upgrade existing routes to deliver acceptable high-speed service while continuing heavy freight service at reasonable costs for all corridor users.

PLANNING TECHNOLOGY **($1,518,000)**

Funding for planning technology is $268 thousand above the FY 1996 enacted level. Funds will be used to develop and evaluate detailed models and planning methods to address the coordination of new high-speed service with existing corridor freight and passenger traffic. The success of incremental high-ed rail options depends heavily on the ability to utilize sting freight railroads for more intensive passenger service. Given this need for mixed use and multiple operators, an effective operations coordination mechanism--assuring that all needs, freight, intercity passenger, and commuter, are met--is an absolute prerequisite to implementation of **reliable** high-speed rail. Suitable methods and techniques will be developed by intensively examining outstanding examples of operations coordination in a high-speed rail setting (as exemplified by the Pacific Northwest Corridor, where the States of Oregon and Washington and the Burlington Northern Santa Fe and Union Pacific Railroads have collaborated in positive train control activities). The methods resulting from this effort will be demonstrated in actual State HSGT projects in subsequent years.

ADMINISTRATION **$428,000**

Funding supports the management and administrative expenses of the high-speed ground transportation programs described under this budget request. The increase of $27 thousand is associated with costs over which FRA has no control, such as the FY 1997 pay raise, annualization of the FY 1996 comparability and locality pay raises and increased vendor/inflation costs.