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POSITIVE TRAIN CONTROL SYSTEMS

REGULATORY IMPACT ANALYSIS

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Executive Summary

The accompanying final rule provides new performance standards for the implementation and operation of Positive Train Control (PTC) systems as mandated by the Railroad Safety Improvement Act of 2008 (RSIA08) and as otherwise voluntarily applied. The final rule also details the process and identifies the documents that railroads and operators of passenger trains are to utilize and incorporate in their PTC implementation plans required by RSIA08. The final rule also details the process and procedure for obtaining FRA approval of such plans.

FRA is required to analyze the final rule under Executive Order 12866. FRA's analysis presents a 20-year analysis of the costs and benefits associated with FRA's final rule, using both 7 percent and 3 percent discount rates, including net present value (PV) and annualized value, which is the annuity required at the discount rate to yield the total over the analysis period. It also presents two types of sensitivity analyses. The first is associated with varying cost assumptions used for estimating PTC implementation costs. The second takes into account potential business benefits from realizing service efficiencies and related additional societal benefits from environmental attainment and an overall reduction in transportation risk from modal diversion.

The 20-year total cost estimates are $9.55 billion (Present Value [PV], 7%) and $13.21 billion (PV, 3%). Annualized costs are $0.87 billion (PV, 7%) and $0.88 billion (PV, 3%). Using high-cost assumptions, the 20-year total cost estimates would be $16.25 billion (PV, 7%) and $22.54 billion (PV, 3%). Using low-cost assumptions, the 20-year cost estimates would be $6.73 billion (PV, 7%) and $9.34 billion (PV, 3%). The later the expenditures are made, the lower the discounted cost impact, which in any event is a very small portion of the total PTC costs. This estimate is lower than the cost estimate presented in the NPRM. It reflects the low freight traffic volume exception for passenger train routes. This exception results in lower wayside costs than estimated in the NPRM RIA. FRA has not revised its locomotive cost estimates to reflect reduced burden resulting from the additional flexibility granted because the magnitude of the reduction is very small relative to the overall system cost. The costs would make the rule significant, and the costs would far exceed the benefits, but FRA is constrained by the requirements of RSIA08, which does not give FRA any latitude to avoid promulgating the final rule, or one which achieves the same ends.

Twenty-year railroad safety (railroad accident reduction) benefit estimates associated with implementation of the rule are $440 million (PV, 7%) and $674 million (PV, 3%). Annualized benefits are $42 million (PV, 7%), and $45 million (PV, 3%). This estimate is lower than that estimated at the NPRM stage of the rulemaking. The estimate was lowered as a result of revisions made to a study performed by Volpe Center regarding the cost of PTC-preventable accidents. Some forecasts predict significant growth of both passenger and freight transportation demands, and it is thus possible that greater activity on the system could present the potential for larger safety benefits than estimated in this analysis. The presence of a very large PTC-equipped freight locomotive fleet also supports the opportunity for introduction of new passenger services of higher quality at less cost to the sponsor of that service. Information is not currently available to quantify that benefit.

Table E-1 below provides a summary of costs and benefits by expected cost, high cost, and low cost cases, including annualization, using a 3% discount rate as well as a 7% discount rate.

Summary Table

Discount Rate	**3%**	**7%**
Discounted 20-Year Values		
Expected Costs	$13,205,614,091	$9,547,522,721
High Costs	$22,538,964,023	$16,248,602,279
Low Costs	$9,339,958,681	$6,729,146,218
Railroad Safety Benefits	$673,801,919	$439,705,397
Annualized 20-Year Values		
Expected Costs	$882,900,648	$901,218,603
High Costs	$1,514,972,415	$1,529,021,560
Low Costs	$627,791,932	$630,452,251
Railroad Safety Benefits	$45,290,073	$41,505,079

Table E-2 below presents cost and benefit breakdown estimates by element using a 3% discount rate as well as a 7% discount rate.

Table E-2, Summary Breakdown of Costs and Benefits

Total 20-Year Discounted Costs and Benefits (at 3% and 7%)

Discount Rate	3.00%	7.00%
Costs		
Central Office and Development	$283,025,904	$263,232,675
Wayside Equipment	$2,902,751,825	$2,414,794,033
On-Board Equipment	$1,613,568,678	$1,390,618,364
Maintenance	$8,406,267,684	$5,478,877,649
Total	$13,205,614,091	$9,547,522,721
Benefits by Category		
Fatalities	$268,999,278	$175,541,848
Injuries	$203,984,196	$133,114,717
Train Delay	$24,530,630	$16,008,043
Property Damage	$159,149,846	$103,857,000
Emergency Response	$431,143	$281,353
Equipment Clean Up	$2,509,576	$1,637,683
Road Closure	$580,664	$378,926
Environmental Cleanup	$6,486,888	$4,233,172

Evacuations	$7,129,699	$4,652,654
Total Railroad Safety Benefits	$673,801,919	$439,705,397

FRA has taken several steps to further avoid triggering unnecessary costs in the final rule. For instance, FRA is not requiring use of separate monitoring of switch position in signal territory or that the system be designed to determine the position of the end of the train. FRA also minimized costs by imposing a requirement to monitor derails protecting the mainline, but limiting it to derails connected to the signal system; and by imposing a requirement to monitor hazard detectors protecting the mainline, but limiting it to hazard detectors connected to the signal system. FRA also minimized costs related to diamond crossings, where a PTC equipped railroad crosses a non-PTC equipped railroad at grade; included exceptions to main track for passenger train operations, including additional exceptions which were not in the proposed rule, and provided provisions that would permit some Class III railroad operation of trains not equipped with PTC over Class I freight lines equipped with PTC. All commuter operations connected to the general railroad system of transportation, which include all current commuter rail operations, will be subject to the final rule. Note that Port Authority Trans Hudson Railroad (PATH) is not physically connected to the general freight system yet is considered a commuter railroad for all purposes. PATH formerly was part of the general freight system and remains under FRA safety jurisdiction. Rapid transit systems, such as the Washington Metro Area Transit Authority (WMATA) and New York City Transit Authority (NYCTA), would not be impacted.

Some of the costs of PTC implementation, operation, and maintenance may be offset by business benefits, especially in the long run, although there is uncertainty regarding the timing and level of those benefits. Economic and technical feasibility of the necessary system refinements and modifications to yield the potential business benefits has not yet been demonstrated. Nevertheless, FRA believes that there is opportunity for significant business benefits to accrue several years after implementation once the systems have been refined to the degree necessary. Thus, FRA conducted a sensitivity analysis of potential business benefits from fuel savings attributable to train pacing, precision dispatch, and capacity enhancement.

Developing technology and rising fuel costs have caused the rail supply industry and the railroads to focus on additional means of conserving diesel fuel while minimizing in-train forces that can lead to derailments and delays from train separations (usually broken coupler knuckles). Further integrating this technology with PTC communications platforms and traffic planning capability could permit transmittal of “train pacing” information to the locomotive cab in order to conserve fuel. The diesel fuel use for road operations on the Class I railroads is approximately 3.5 billion gallons annually, which is $8.75 billion at $2.50 per gallon. If PTC helps to potentiate the growth and effective use of train pacing, fuel savings of 5% ($437,500,000 annually) or greater could very likely be achieved. Clearly, if the railroads are able to conserve use of fuel, they will also reduce emissions and contribute to environmental attainment, even before modal diversion occurs.

The improvements in dispatch and capacity have further implications. With those improvements railroads could improve the reliability of shipment arrival time, and thus dramatically increase the value of rail transportation to shippers, who in turn would divert certain shipments from highway to rail. Such diversion would yield greater overall transportation safety benefit since railroads have much lower accident risk than highways, on a point-to-point ton-mile basis.

At present, the PTC systems contemplated by the railroads, with the possible exception of one, would not increase capacity, at least not for some time. If the locomotive braking algorithms need to be made more conservative in order to ensure that trains do not exceed the limits of their authority, PTC may actually decrease rail capacity where applied in the early years. Further investment would be required to bring about the synergy that would result in capacity gains.

Diversion could result in very significant annual highway safety benefits. Of course, these benefits require that the productivity enhancing systems be added to PTC. Modal diversion would also yield environmental benefits. Modal diversion is highly sensitive to service quality. The sensitivity analysis performed by FRA indicates that realization of business benefits could yield benefits sufficient to close the gap between PTC implementation costs and rail accident reduction benefits within the first 20 years of the rule applying a 3% discount rate and by year 25 of the rule, applying a discount rate of 7%. The precise partition of business and societal benefits cannot be estimated with any certainty.

FRA recognizes that the likelihood of business benefits is uncertain and that the cost-to-benefit comparison of this rule, excluding any business benefits, is not favorable. However, FRA has taken measures to minimize the rule’s adverse impacts and to provide as much flexibility as FRA is authorized to grant under RSIA08.

1. Introduction

FRA is issuing regulations implementing a requirement of the Rail Safety Improvement Act of 2008 that defines criteria for certain passenger and freight rail lines requiring the implementation of positive train control (PTC) systems. The final rule includes required functionalities of PTC system technology and the means by which PTC systems will be certified. The final rule also describes the contents of the PTC implementation plans required by the statute and contains the process for submission of those plans for review and approval by FRA. The regulations could also be voluntarily complied with by entities not mandated to install PTC systems. It is a final rule; however, FRA has identified specific provisions for which we are proposing to make changes to the final rule, if warranted by the public comments received. FRA expects to publish our response to those comments, including any possible changes to the rule made as a result of them, as soon as possible following the end of the comment period. However, the limited areas of this rule open for additional comment do not affect the requirement for railroads to prepare and submit plans in accordance with the deadlines established in the final rule.

While developing the final rule, FRA applied the performance-based principles embodied in existing subpart H of part 236 to identify and remedy any weaknesses discovered in the subpart H regulatory approach, while exploiting lessons learned from products developed under subpart H. FRA has continued to make performance-based safety decisions while supporting railroads in their development and implementation of PTC system technologies. Development of the final rule was enhanced with the participation of the Railroad Safety Advisory Committee (RSAC), which tasked a PTC Working Group to provide advice regarding development of implementing regulations for PTC systems and their deployment that are required under the RSIA08. The PTC Working Group made a number of consensus recommendations, which were identified and included in the proposed rule, and the RSAC has contributed further refinements in the form of recommendations for resolution of the public comments. The preamble to the final rule discusses the statutory background, the regulatory background, the RSAC proceedings, the alternatives considered and the rationale for the option selected, the proceedings to date, as well as the comments and conclusions on general issues. Other comments and resolutions are discussed within the corresponding section-by-section analysis.

2. Background

2.1. The Need for Positive Train Control Technology

Since the early 1920s, systems have been in use that can intervene in train operations by warning crews or causing trains to stop if they are not being operated safely because of inattention, misinterpretation of wayside signal indications, or incapacitation of the crew. Pursuant to orders of the Interstate Commerce Commission (ICC) ―whose safety regulatory activities were later transferred to the Federal Railroad Administration (FRA) when the FRA was established in 1967―cab signal systems, automatic train control, and automatic train stop systems were deployed on a significant portion of the national rail system to supplement and enforce the indications of wayside signals and operating speed limitations. However, these systems were expensive to install and maintain, and with the decline of intercity passenger service following the

Second World War, the ICC allowed many of these systems to be discontinued. During this period railroads were heavily regulated with respect to rates and service responsibilities. The development of the Interstate Highway System and other factors led to reductions in the railroads' revenues without regulatory relief, leading to bankruptcies, railroad mergers, and eventual abandonment of many rail lines. Consequently, railroad managers focused on fiscal survival and investments in expensive relay-based train control technology were economically out of reach. The removal of these train control systems, which had never been pervasively installed, permitted train collisions to continue, notwithstanding enforcement of railroad operating rules designed to prevent them.

As early as 1970, following its investigation of the August 20, 1969, head-on collision of two Penn Central Commuter trains near Darien, Connecticut, in which 4 people were killed and 45 people were injured, the National Transportation Safety Board (NTSB) asked the FRA to study the feasibility of requiring a form of automatic train control system to protect against operator error and prevent train collisions. Following the Darien accident, the Safety Board continued to investigate one railroad accident after another caused by human error. During the next two decades, the Board issued a number of safety recommendations asking for train control measures. Following its investigation of the May 7, 1986, rear-end collision involving a Boston and Maine Corporation commuter train and a Consolidated Rail Corporation (Conrail) freight train in which 153 people were injured, the Safety Board asked the FRA to promulgate standards to require the installation and operation of a train control system that would provide for positive train separation (R-87-16). When the NTSB first established its Most Wanted List of Transportation Safety Improvements in 1990, the issue of Positive Train Separation was among the improvements listed, and it remained on the list until just after enactment of the RSIA. The NTSB continues to follow the progress of implementation closely and participated through staff in the PTC Working Group deliberations.

Meanwhile, enactment of the Staggers Rail Act of 1980 signaled a shift in public policy that permitted the railroads to shed unprofitable lines, largely replace published "tariffs" with appropriately priced contract rates, and generally respond to marketplace realities, which increasingly demanded flexible service options responsive to customer needs. The advent of microprocessor-based electronic control systems and digital data radio technology during the mid-1980s led the freight railroad industry, through the Association of American Railroads (AAR) and the Railway Association of Canada, to explore the development of Advanced Train Control Systems (ATCS). With broad participation by suppliers, railroads, and the FRA, detailed specifications were developed for a multi-level "open" architecture that would permit participation by many suppliers while ensuring that systems deployed on various railroads would work in harmony as trains crossed corporate boundaries. ATCS was intended to serve a variety of business purposes, in addition to enhancing the safety of train operations.

Pilot versions of ATCS and a similar system known as Advanced Railroad Electronic Systems (ARES) were tested relatively successfully, but the systems were never deployed on a wide scale primarily due to cost. However, sub-elements of these systems were employed for various purposes, particularly for replacement of pole lines associated with signal systems.

Collisions, derailments, and incursions into work zones used by roadway workers continued as a result of the absence of effective enforcement systems designed to compensate for effects of fatigue and other human factors. Renewed emphasis on rules compliance and federal regulatory initiatives, including rules for control of alcohol and drug use in railroad operations, operating rules testing of rail employees, requirements for qualification and certification of locomotive engineers, and negotiated rules for roadway worker protection led to some reduction in risk, but the lack of an effective collision avoidance system still allowed the continued occurrence of accidents, some involving tragic losses of life and significant property damage.

2.2 Earlier Efforts to Encourage Voluntary PTC Implementation

As the NTSB continued to highlight the opportunities for accident prevention associated with emerging train control technology through its investigations and findings, the Congress showed increasing interest, mandating three separate reports over the period of a decade. In 1994, the FRA reported to the Congress on this problem, calling for implementation of an action plan to deploy PTC systems (Railroad Communications and Train Control, July 1994 (hereinafter "1994 Report")). The 1994 Report forecasted substantial benefits of advanced train control technology to support a variety of business and safety purposes, but noted that an immediate regulatory mandate for PTC could not be currently justified based upon normal cost-benefit principals relying on direct safety benefits. The report outlined an aggressive Action Plan implementing a public-private sector partnership to explore technology potential, deploy systems for demonstration, and structure a regulatory framework to support emerging PTC initiatives.

Following through on the 1994 Report, FRA committed approximately $40 million through the Next Generation High Speed Rail Program and the Research and Development Program to support development, testing, and deployment of PTC prototype systems in the Pacific Northwest, Michigan, Illinois, Alaska, and the Eastern railroads. As called for in the Action Plan, FRA also initiated a comprehensive effort to structure an appropriate regulatory framework for facilitating voluntary implementation of PTC and for evaluating future safety needs and opportunities.

In September of 1997, the Federal Railroad Administrator asked the RSAC to address the issue of Positive Train Control. The RSAC accepted three tasks: Standards for New Train Control Systems (Task 1997-06), Positive Train Control Systems-Implementation Issues (Task 1997-05) and Positive Train Control Systems-Technologies, Definitions, and Capabilities (Task 1997-04) The PTC Working Group was established, comprised of representatives of labor organizations, suppliers, passenger and freight railroads, other federal agencies, and interested state departments of transportation. The PTC Working Group was supported by the FRA counsel and staff, analysts from the Volpe National Transportation Systems Center, and advisors from the NTSB staff.

In 1999, the PTC Working Group provided to the Federal Railroad Administrator a consensus report ("1999 Report") with an indication that it would be continuing its efforts. The report defined the PTC core functions to include: prevention of train-to-train collisions (positive train separation); enforcement of speed restrictions, including civil engineering restrictions (curves, bridges, etc.) and temporary slow orders; and protection for roadway workers and their equipment operating under specific authorities. The PTC Working Group identified additional safety functions that might be included in some PTC architectures: provide warning of on-track equipment operating outside the limits of authority; receive and act upon hazard information, when available, in a more timely or more secure manner (e.g., compromised bridge integrity, wayside detector data); and provide for future capability by generating data for transfer to highway users to enhance warning at highway-rail grade crossings. The PTC Working Group stressed that efforts to enhance highway-rail grade crossing safety must recognize the train's necessary right of way at grade crossings and that it is important that warning systems employed at highway-rail grade crossings be highly reliable and "fail-safe" in their design.

As the PTC Working Group's work continued, other collaborative efforts, including development of Passenger Equipment Safety Standards (including private standards through the American Public Transit Association), Passenger Train Emergency Preparedness rules, and proposals for improving locomotive crashworthiness (including improved fuel tank standards) have targeted reduction in collision and derailment consequences.

In 2003, in light of technological advances and potential increased cost and system savings related to prioritized deployment of these systems, the Appropriations Committees of the Congress requested FRA to update the costs and benefits for the deployment of PTC and related systems. As requested, FRA carried out a detailed analysis that was filed in August of 2004 ("2004 Report"), which indicated that under one set of highly controversial assumptions, substantial public benefits would likely flow from the installation of PTC systems on the railroad system. Further, the total amount of these benefits was subject to considerable controversy. While many of the other findings of the 2004 Report were disputed, there was no data submitted to challenge the 2004 Report finding that reaffirmed earlier conclusions that the safety benefits alone of PTC systems were relatively small in comparison to the large capital and maintenance costs. Accordingly, FRA continued to believe that an immediate regulatory mandate for widespread PTC implementation could not be justified based upon normal cost-benefit principles relying on direct railroad safety benefits.

Despite the economic infeasibility of PTC based on safety benefits alone, as outlined in the 1994, 1999, and 2004 Reports, FRA continued with regulatory and other efforts to facilitate and encourage the voluntary installation of PTC systems. As part of the High Speed Rail Initiative, and in conjunction with the National Railroad Passenger Corporation (Amtrak), the Association of American Railroads (AAR), the State of Illinois, and the Union Pacific Railroad Company (UP), FRA created the North American Joint Positive Train Control (NAJPTC) Program, which set out to describe a single standardized open source PTC architecture and associated standards. UP's line between Springfield and Mazonia, Illinois, was selected to initial installation of a train control system to support Amtrak operations up to 110 mph, and the system was installed and tested on portions of that line. Although the system did not prove viable as then conceived, the project hastened the development of PTC technology that was subsequently employed in other projects. Promised standards for interoperability of PTC systems also proved elusive.

In addition to financially supporting the NAJPTC Program, FRA continued to work with the rail carriers, rail labor, and suppliers on regulatory reforms to facilitate voluntary PTC implementation. The regulatory reform effort culminated when FRA issued a final rule on March 7, 2005, establishing a technology neutral safety-based performance standard for processor-based signal and train control systems. This new regulation, codified as subpart H to part 236 of title 49 of the Code of Federal Regulations (CFR), was carefully crafted to encourage the voluntary implementation and operation of processor-based signal and train control systems without impairing technological development. 70. Fed. Reg. 11052 (Mar. 7, 2005).

FRA intended for the final rule--developed in close cooperation with rail management, rail labor, and suppliers--to further facilitate individual railroad efforts to voluntarily develop and deploy cost effective PTC technologies that would make system-wide deployment more economically viable. It also appeared very possible that major railroads would elect to make voluntary investments in PTC to enhance safety, improve service quality and foster efficiency (e.g., better asset utilization, reduced fuel use through train pacing).

2.3 Technology Adopted Before RSIA08

While FRA and RSAC worked to develop consensus on the regulations that would become subpart H, the railroads continued with PTC prototype development. The technology neutral, performance-based regulatory process established by subpart H proved to be very successful in facilitating the development of other PTC implementation approaches. Although the railroads prototype development efforts were generally technically successful and offered significant improvements in safety, costs of nationwide deployment continued to be untenable. Information gained from prototype efforts did little to reduce the estimated costs for widespread implementation of the core PTC safety functions on the nation's railroads.

Working under subpart H, UP, CSX Transportation, Inc. (CSX), the BNSF Railway Company (BNSF), and the Norfolk Southern Corporation (NS) undertook more aggressive design and implementation work. The new subpart H regulatory approach also made it feasible for smaller railroads such as the Alaska Railroad and the Ohio Central Railroad to begin voluntary design and implementation work on PTC systems that best suited their needs. FRA provided, and continues to provide, technical assistance and guidance regarding regulatory compliance to enable the railroads to more effectively design, install, and test their respective systems.

In December 2006, FRA approved the initial version of the Electronic Train Management System (ETMS®[1]) product for deployment on 35 of BNSF's subdivisions ("ETMS I Configuration") comprising single track territory which was either non-signaled or equipped with traffic control systems. In a separate proceeding, FRA agreed that ETMS could be installed in lieu of restoring a block signal system on a line for which discontinuance had been authorized followed by a significant increase in traffic. During the same period BNSF successfully demonstrated a Switch Point Monitoring System (SPMS)[2] and Track Integrity Warning System (TIWS)[3], a system that electronically reports to the railroad's central dispatching office or the crew of an approaching train if there are any breaks in the rail that might lead to derailments—both of which FRA believes are technologies that help to reduce risk in non-signaled territory and that are forward-compatible

[1] ETMS is a registered trademark of Wabtec Railway Electronics. BNSF Railway has also referred to its application of this technology as "ETMS."
[2] Switch Point Monitoring Systems (SPMS) are systems that contain devices attached to switches that electronically report the position of the switches to the railroads central dispatching office and/or the crew of an approaching train.
[3] Track Integrity Warning Systems (TWIS) are systems that electronically report to the railroad's central dispatching office and/or the crew of an approaching train if there are any breaks in the rail that might lead to derailments.

with PTC. To be forward-compatible, not to be confused with the similar concept of extensibility, a system must be able to gracefully accept input intended for use in later system versions. The introduction of a forward compatible technology implies that old devices can partly understand data generated by new devices. The concept can be applied to electrical interfaces, telecommunication signals, data communication protocols, file formats, and computer programming languages. A standard supports forward compatibility if older product versions can receive, read, view, play or execute the new standard. In the case of wayside devices, they are said to be forward-compatible if they can appropriately communicate and interact with a PTC system when later installed. A wayside device might serve the function of providing only information or providing information and accepting commands from a new system.

In addition to scheduling the installation of the ETMS I Configuration as capital funding became available, BNSF voluntarily undertook the design and testing of complementary versions of ETMS that would support BNSF operations on more complex track configurations, at higher allowable train speeds, and with additional types of rail traffic. Meanwhile, CSXT was in the process of redesigning and relocating the test bed for it its Communications Based Train Management (CBTM) system, which it has tested for several years, and UP and NS were working on similar systems using vital on-board processing.

As congressional consideration of legislation that resulted in the RSIA commenced, all four major railroads had settled on the core technology developed for them by Wabtec Railway Electronics (Wabtec). As the legislation progressed, the railroads and Wabtec worked toward greater commonality in the basic functioning of the on-board system with a view toward interoperability. Accordingly, ETMS is the forerunner of one type of PTC system architecture. Examples of ETMS-derived architecture include the non-vital PTC systems of BNSF's ETMS I and ETMS II, CSXT's Communications CBTM UP's Vital Train Management System (VTMS) and NS's Optimized Train Control (OTC). Further work is been undertaken by BNSF to further the capability of ETMS by integrating Amtrak operations (ETMS III). For a description of system enhancements planned by BNSF as of the Product Safety Plan filing, see FRA Docket No. 2006-23687, Document 0017, at pp. 40-43 (at Regulations.gov).

While the freight railroads' efforts for developing and installing PTC systems progressed over a relatively long period of time, starting with demonstrations of ATCS and ARES in the late 1980s and culminating in the initial Product Safety Plan approval in December of 2006, the National Railroad Passenger Corporation (Amtrak) demonstrated its ability to turn on revenue-quality PTC systems on its own railroad in support of high speed rail.

Beginning in the early 1990's, Amtrak developed plans for enhanced high speed service on the Northeast Corridor (NEC), which included electrification and other improvements between New Haven and Boston and introduction of the Acela trainsets as the premium service from Washington to New York and New York to Boston. In connection with these improvements, which support train speeds up to 150 mph, Amtrak undertook to install the Advanced Civil Speed Enforcement System (ACSES) as a supplement to existing cab signals and automatic train control (speed control). Together, these systems deliver PTC core functionalities. In support of this effort, FRA issued an order for the installation of the system, which required all passenger and freight operators in the New Haven-Boston segment to equip their locomotives with ACSES (63

FR 39343; July 22, 1998). ACSES was installed between 2000 and 2002, and has functioned successfully between New Haven and Boston, and on selected high speed segments between Washington and New York for a number of years.

Amtrak voluntarily began development of an architecturally different PTC system, the Incremental Train Control System (ITCS), for installation on its Michigan Line. Amtrak developed and installed ITCS under waivers from specific sections of 49 CFR part 236, subparts A through G, granted by FRA. ITCS was applied to tenant NS locomotives as well as Amtrak locomotives traversing the route. Highway-rail grade crossings on the route were fitted with ITCS units to pre-start the warning systems for high-speed trains and to monitor crossing warning system health in real time. The system was tested extensively in the field for safety and reliability, and it was put in revenue service in 2001. As experience was gained, FRA authorized increases in speed to 95 mph; and FRA is currently awaiting final results of an independent assessment of verification and validation for the system with a view toward authorizing operations at the design speed of 110 mph.

Despite these successes, the widespread deployment of these various train control systems, particularly on the general freight system, remained very much constrained by prohibitive capital costs. While the railroads were committed to installing these new systems to enhance the safety afforded to the public and their employees, the railroad's actual widespread implementation remained forestalled due to an inability to generate sufficient funding for these new projects in excess of the capital expenditures necessary to cover the ongoing operating and maintenance costs. Accordingly, the railroads continued to plan very slow deployments of PTC system technologies.

2.4 The Rail Safety Improvement Act of 2008

On May 1, 2007, the House of Representatives introduced H.R. 2095, which would, among other things, mandate the implementation and use of PTC systems. The bill passed the House on October 17, 2007, and passed the Senate after amendment on August 1, 2008. On September 24, 2008, the House concurred with the Senate amendment with another amendment pursuant to H. Res. 1492, and on October 1, 2008, the Senate concurred with the House amendment. When considering the House's amendment on October 1, various Senators made statements referencing earlier train accidents that were PTC-preventable. For instance, Senator Lautenberg (NJ) took notice of the collision at Graniteville, South Carolina in 2005, and Senators Lautenberg, Hutchinson (TX), Boxer (CA), Levin (MI), and Carper (DE) took notice of an accident at Chatsworth, California, on September 12, 2008. According to Senator Levin, federal investigators have said that a collision warning system could have prevented that crash and the subject legislation would require that new technology to prevent crashes be installed in high risk tracks. Senators Carper and Boxer made similar statements, indicating that PTC systems are designed to prevent train derailments and collisions, like the one in Chatsworth. Congressional Record 10283-10290, Oct. 1, 2008. Ultimately, on October 1, 2008, the Senate concurred with the House amendment.

The Graniteville accident referenced by Senator Lautenberg was an early morning collision between two NS trains in non-signal (dark) territory near the Avondale Mills Textile plant. One of the trains—which was transporting chlorine gas, sodium hydroxide, and cresol—approached an improperly lined hand-operated switch. As the train diverged through the switch, it ran onto the siding track where it collided with a parked train. Various tank cars ruptured, releasing at least 90 tons of chlorine gas. Nine people died due to chlorine inhalation, and at least 250 people were treated for chlorine exposure. In addition, 5,400 residents within a mile of the crash site were forced to evacuate for nearly two weeks while hazardous materials (hazmat) teams and cleanup crews decontaminated the area.

The Chatsworth train collision occurred on the afternoon of September 12, 2008, when a Union Pacific freight train and a Metrolink commuter train collided head-on a single main track equipped with a Traffic Control System (TCS) in the Chatsworth district of Los Angeles, California. Although NTSB has not yet released its final report, evidence summarized at the NTSB's public hearing suggested that the Metrolink passenger train operated past a signal displaying a stop indication and entered a section of single track where the opposing UP freight train was operating on a signal indication permitting it to proceed over a switch and into a siding (after which the switch would have been lined for the Metrolink train to proceed). As a consequence of the accident, 25 people died and over 130 more were seriously injured.

Prior to the accidents in Graniteville and Chatsworth, the railroads' slow incremental deployment of PTC technologies—while not uniformly agreed upon by the railroads, FRA, and NTSB—was generally deemed acceptable by them in view of the tremendous costs involved. Partially as a consequence and severity of these very public accidents, coupled with a series of other less publicized accidents, Congress passed the RSIA08 into law on October 16, 2008, marking a public policy decision that, despite the implementation costs, railroad employee and general public safety warranted mandatory and accelerated installation and operation of PTC systems.

As immediately relevant to this rulemaking, the RSIA08 requires the installation and operation of PTC systems on all main lines, meaning all intercity passenger and commuter railroad lines—with limited exceptions entrusted to FRA—and on freight-only lines when they are owned by Class I railroads, carrying at least 5 million gross tons of freight annually, and carrying any amount of toxic by inhalation (TIH) or poison by inhalation (PIH) materials.

In RSIA08, Congress established very aggressive dates for PTC system build-out completion. Each subject railroad is required to submit to FRA by April 16, 2010, a PTC Implementation Plan (PTCIP) indicating where and how it intends to install PTC systems by December 31, 2015.

In light of timetable instituted by Congress, and to better support railroads with their installation while maintaining safety, FRA decided that it is appropriate for mandatory PTC systems to be reviewed by FRA differently than the regulatory approval process provided under subpart H. FRA believes that it is important to develop a process more suited specifically for PTC systems that would better facilitate railroad reuse of safety documentation and simplify the process of showing that the installation of the PTC system did not degrade safety. FRA also believes that subpart H does not clearly address the statutory mandates and that such lack of clarity would complicate railroad efforts to comply with the new statutory requirements. Accordingly, FRA is amending part 236 by modifying existing subpart H and adding a new subpart I.

2.5 RSAC

In March 1996, FRA established the RSAC, which provides a forum for collaborative rulemaking and program development. The Committee includes representation from all of the agency's major customer groups, including railroads, labor organizations, suppliers and manufacturers, and other interested parties. When appropriate, FRA assigns a task to RSAC, and after consideration and debate, RSAC may accept or reject the task. If accepted, RSAC establishes a working group that possesses the appropriate expertise and representation of interests to develop recommendation to FRA for action on the task. These recommendations are developed by consensus. The working group may establish one or more task forces or other subgroups to develop facts and options on a particular aspect of a given task. The task force, or other subgroup, reports to the working group. If a working group comes to consensus on recommendations for action, the package is presented to the RSAC for a vote. If the proposal is accepted by a simple majority of the RSAC, the proposal is formally recommended to FRA. FRA then determines what action to take on the recommendation. Because FRA staff has played an active role at the working group and subgroup levels in discussing the issues and options and in drafting the language of the consensus proposal, and because the RSAC recommendation constitutes the consensus of some of the industry's leading experts on a given subject, FRA is generally favorably inclined toward the RSAC recommendation. However, FRA is in no way bound to follow the recommendation and the agency exercises its independent judgment on whether the recommended rule achieves the agency's regulatory goals, is soundly supported, and was developed in accordance with the applicable policy and legal requirements. Often, FRA varies in some respects from the RSAC recommendation in developing the actual regulatory proposal.

In developing the accompanying rulemaking, FRA adopted the RSAC PTC working group and task force approach to ensure that the new regulation is neither arbitrary nor capricious or exceeds its statutory authority. As part of this effort, FRA is working with the major stakeholders affected by this subpart in as much a collaborative manner as possible. FRA believes establishing a collaborative relationship early in not only the product development cycle, but the regulatory development cycle, can help to bridge the divide between the railroad carrier's management, railroad labor organizations, the suppliers, and the FRA by ensuring that all stakeholders are working with the same set of data and have a common understanding of product characteristics or their related processes production methods, including the regulatory provisions, with which compliance is mandatory. However, where the group fails to reach consensus on a recommendation proposed by the various stakeholders, FRA will resolve the issue on its own, attempting to reconcile as many of the divergent positions as possible through traditional rulemaking proceedings.

2.6 PTC Working Group

On December 10, 2008, the RSAC accepted a task (No. 08-04) entitled "Implementation of Positive Train Control Systems." The purpose of this task was defined as follows: "To provide advice regarding development of implementing regulations for Positive Train Control (PTC) systems and their deployment under the Rail Safety Improvement Act of 2008." The task called for the RSAC PTC Working Group to perform the following:

1. Review the mandates and objectives of the Act related to deployment of PTC systems;
2. Help to describe the specific functional attributes of systems meeting the statutory purposes in light of available technology;
3. Review impacts on small entities and ascertain how best to address them in harmony with the statutory requirements;
4. Help to describe the details that should be included in the implementation plans that railroads must file within 18 months of enactment of the Act;
5. Offer recommendations on the specific content of implementing regulations; and
6. The task also required the PTC Working Group to:
7. Report on the functionalities of PTC systems;
8. Describe the essential elements bearing on interoperability and the requirements for consultation with other railroads in joint operations; and
9. Determine how PTC systems will work with the operation of non-equipped trains.

From January to April 2009, FRA met with the entire PTC Working Group five times over the course of twelve days. During those meetings, in order to efficiently accomplish the tasks assigned to it, the PTC Working Group empowered three task forces to work concurrently. These task forces included the passenger, short line and regional railroad, and the radio and communications task forces. Each discussed issues specific to their particular interests and needs and produced proposed rule language for the PTC Working Group's consideration. The majority of the proposals were adopted into the final rule as agreed upon by the working group, with rule language related to a remaining few issues being further discussed and enhanced for inclusion into the rule by the PTC Working Group.

The passenger task force discussed testing issues relating to parts 236 and 238 and the definition of "main line" under the statute, including possible passenger terminal and limited operations exceptions to PTC implementation. Recommendations of the task force were presented to the Working Group, which adopted or refined each suggestion.

The short line and regional railroad task group was formed to address the questions pertaining to Class II and Class III railroads. Specifically, the group discussed issues regarding the trackage rights of Class II and III railroads using trains not equipped with PTC technology over a Class I railroad's PTC territory, passenger service over track owned by a Class II or Class III railroads where PTC would not otherwise be required, and railroad crossings at grade involving a Class I railroad's PTC equipped train and an Class II or III railroad's PTC unequipped train. After much discussion, there were no resolutions reached on any of the main issues raised. However, the discussion yielded insights utilized by FRA in preparing this final rule.

The radio and communications task force addressed wireless communications issues, particularly as they relate to communications security, and recommended language for § 236.1033.

FRA staff worked with the PTC Working Group and its task forces. FRA gratefully acknowledges the participation and leadership of representatives who served on the PTC Working Group and its task forces. These points are discussed to show the origin of certain issues and the course of discussion on these issues at the task force and working group levels. We believe this helps illuminate the factors FRA weighed in making its regulatory decisions regarding this final rule and the logic behind those decisions.

In general, the PTC working group agreed on the process for implementing PTC under the statute, including decisional criteria to be applied by FRA in evaluating safety plans, adaptation of subpart H principles to support this mandatory implementation, and refinements to subpart H and the part 236 appendices necessary to dovetail the two regulatory regimes and take lessons from early implementation of subpart H, including most aspects of the training requirements. Notable accords were reached, as well, on major functionalities of PTC and on exceptions applicable to passenger service (terminal areas and main line exceptions). Major areas of disagreement included whether to allow non-equipped trains on PTC lines, extension of PTC to lines not within the statutory mandate, and whether to provide for onboard displays or terminals accessible to employees other than the locomotive engineer when two or more persons are regularly assigned duties in the cab. Some additional areas of concern were discussed but could not be resolved in the time available. It was understood that where discussion did not yield agreement, FRA would make proposals and receive public comment.

2.7 Public Hearing and Comments Filed

FRA issued a Notice of Proposed Rulemaking (NPRM) on July 21, 2009 and accepted comments on this proposed regulation until August 20, 2009. A public hearing was also held in Washington, DC on August 13, 2009, as further described below.

During the comment period, a number of entities filed comments requesting that FRA extend the comment period to the proposed rule in this proceeding. FRA regrettably denied those requests due to the urgent need to prepare, process, and publish a final rule at the earliest possible date. Since railroads subject to the rules are each required to file a PTCIP by April 16, 2010, under the terms of the RSIA08, it was important that FRA provide reliable guidance for this process to occur in a timely manner. However, FRA responded to two of those requests on the record, indicating that it is FRA’s policy to consider late-filed comments to the extent practicable and inviting the railroads to supplement their comments as soon as possible even if it is necessary to file after the formal comment period has closed.

On August 13, 2009, FRA held a hearing to provide interested parties an opportunity to enter oral statements into the record. The AAR, BNSF, and CSXT entered prepared statements into the record and UP and NS indicated their concurrence with those statements. An oral statement was also entered into the record by a representative of six (6) rail labor organizations, including the American Train Dispatchers Association (ATDA), the Brotherhood of Locomotive Engineers and Trainmen (BLET), the Brotherhood of Maintenance of Way Employees Division (BMWED), the Brotherhood of Railroad Signalmen (BRS), the International Brotherhood of Electrical Workers (IBEW), and the United Transportation Union (UTU) (collectively, the “Rail Labor Organizations” or “RLO”). The American Association of State Highway and Transportation Officials (AASHTO) also provided an oral statement at the hearing, indicating that it fully supports the implementation of the proposed rule. Copies of prepared statements and of the hearing transcript can be found in the docket to this proceeding.

Subsequently, written comments were filed by AAR, CSXT, BNSF, Canadian Pacific (CP), RLO, Amtrak, the Utah Transit Authority (UTA), The Chlorine Institute (CI), GE Transportation (GE), Invensys Rail Group—Safetran Systems ("Safetran"), NJ TRANSIT, New York State Metropolitan Transportation Authority (NYSMTA), the Northern Indiana Commuter Transportation District (NICTD), Southern California Regional Rail Authority (SCRRA or Metrolink), American Public Transportation Association (APTA), American Chemistry Council (ACC), HCRQ, Inc. and Cattron Group International (collectively, "HCRQ/CGI"), Caltrain, The Fertilizer Institute (TFI), Trinity Railway Express (TRE or Trinity), the National Transportation Safety Board (NTSB), San Bernardino Railway Historical Society, Railroad Passenger Car Alliance, Tourist Railway Association, Friends of the Earth, Invensys Rail Group, and a number of individuals.

Second RSAC Process

After the comment period closed on August 20, 2009, the RSAC PTC Working Group was reconvened for three days. The Working Group agreed on a number of recommendations for resolution of comments which were presented to the full RSAC on September 10. In voting by mail ballot that concluded on September 24, the RSAC adopted the recommendations, which are discussed below in the context of the specific issues which they address.

3. Overview: The Proposed Rule, Comments, and Resolution of Comments

In broad summary, the proposed rule provided for joint filing of PTCIPs by all railroads engaged in joint operations. PTCIPs were to be accompanied or preceded by PTCDPs or PTCSPs detailing the technology to be employed, or by a Type Approval obtained by another railroad through approval of a PTCDP. As further discussed below, this general structure was generally embraced by the industry parties and the commenters; but the extended period for delivery of interoperability standards has given rise to the need for some significant adjustments that are included in the final rule.

Under the NPRM language, Class I freight railroads would be required to describe in their PTCIPs the routes to be equipped based on traffic densities (lines carrying more than 5 mgt) and presence of PIH traffic during calendar year 2008. They would be permitted to amend those plans if FRA found that removal of a line was "consistent with safety and in the public interest." The discussion below reflects the serious objections of the Class I railroads to this "base year" approach and adjustments that FRA makes in this final rule to provide somewhat greater flexibility on the face of the regulation. The discussion and final rule also provide FRA's response to a suggestion by the AAR that FRA create a "de minimis" exception to the requirement that lines carrying PIH traffic be equipped with PTC, an issue raised for the first time in response to the NPRM.

FRA proposed to adapt the performance-based structure of subpart H, part 236, Code of Federal Regulations, which had been developed through the consensus process to encourage deployment of PTC and related technologies to provide a means of qualifying PTC under the RSIA08. In order to promote completion of PTC deployment by the end of 2015, as required by law, FRA proposed functional requirements that could be met by available technology. These provisions continue to enjoy broad support from the industry parties and commenters, but the final rule makes numerous perfecting changes to the implementing language in response to specific comments.

The NPRM set forth requirements for equipping of trains with PTC that reflected FRA's perception of practical considerations (e.g., not all locomotives can be equipped at once, and switching out locomotives to commit them to equipped routes would involve significant cost and safety exposure), historic tolerance for some incidental unequipped movements under circumstances where strict adherence would create obvious hardship without commensurate safety benefits (e.g., locomotives of Class II and III railroads generally spend little time on Class I railroads and have a good safety record, yet requiring that they be equipped could result in expenditures greater than the previous value of the locomotives), and movement restrictions applicable where lead locomotives might have failed on-board PTC equipment. These proposals elicited some strong objections and proposals for improvement. Several commenters asked that occasional movement of trains led by historic locomotives be permitted without equipping the locomotives with PTC. The final rule makes a number of changes, while endeavoring to carry forward the lessons of many decades and while recognizing the need for regulatory flexibility.

Relying on existing train control requirements, the NPRM proposed that each assigned crewmember be able to view the PTC display and perform assigned functions from their normal position in the cab. The NPRM also addressed the need to avoid task overload on the locomotive engineer by having that person perform functions that could distract from attention to current safety duties. FRA has considered the Class I railroads argument that, if a single display was acceptable under subpart H, it should be acceptable under the proposed subpart I. Although FRA has considered carefully the carriers' arguments on this point, the final rule carries forward principles of crew resource management by ensuring that each crew member has the information and ability to perform their assigned function, and therefore, where a PTC overlay system is used, that all of the safety features of the underlying operation, to which PTC is added, will be kept.

One of the critical choices assigned to FRA under the law was specification of any exceptions to passenger "main track" requiring installation of PTC. The NPRM carried forward narrow exceptions crafted at the request of commuter and intercity railroads. Amtrak followed with comments on the NPRM asking for a broader exception. They noted in particular that the incremental costs of PTC on some lines with limited freight traffic and relatively few Amtrak trains might need to be borne by States that support particular services, and the funding might not be available to do so. Following recommendations from the RSAC Working Group, FRA is including additional latitude to bring forward specific exceptions for FRA review and approval, with or without conditions.

The NPRM was technology neutral and directed at the outcomes desired. A number of the comments addressed the issue of market concentration and absence of effective choices in selecting PTC technology. In this regard, some felt that FRA should specify attributes of interoperability in the form of open standards. The final rule continues to rely on safety performance as the basis for FRA certification of PTC systems. FRA declines at this time to deprive those railroads that have served as technology leaders in developing PTC systems of the latitude to implement their systems, given their apparent willingness to provide open standards for attributes of the technology over which they have control, and given the predictable delays that would ensue should alternative approaches be specified. FRA is aware that this creates a degree of reliance on others with respect to those railroads that stood back and waited for others to develop PTC technology. Further, some degree of market concentration may exist on the general freight network, in particular, given the dominance of one vendor with respect to the core of the on-board systems. FRA financially supported development of interoperability standards through the North American Positive Train Control Program (the technology selected for demonstration was not deployed, and no standards were delivered) and again through the American Railway Engineering and Maintenance Association (standards have been published and are available, but no railroad has signaled an intention to employ them). The choice of technology that will be deployed should, in FRA's view, be made by those who are making the investments.

Finally, the NPRM took a traditional approach to recognition of technology, requiring that railroads step forward, individually or with their suppliers, to request recognition of PTC systems. Suppliers commented that they should be able to step forward without railroad participation and receive recognition for systems, subsystems and components that would later be incorporated in PTC systems approved by FRA. They noted that the NPRM would burden them with reporting obligations while not conferring status to receive direct product recognition. While recognizing the commenters' logic, FRA could not find a means in the final rule to relieve these concerns, given limited technical staffing at FRA, the potential for filings representing technology that the industry would not employ, the inherent difficulty associated with addressing the safety of technology below the system level, and the critical need to provide rapid responses to necessary filings.

Each of the comments on the NPRM, including comments not within the scope of this overview, is discussed in relation to the topic addressed in the section-by-section analysis below. In the section-by section analysis, FRA presents the actual final rule, but the main focus of this analysis is to show how FRA exercised its understanding of the railroad industry and the Congressional intent behind RSIA08 to arrive at a regulatory program that avoids unintended burdens where permitted under Congressional intent, yet delivers the level of safety which Congress intended. It is difficult, if not impossible, to estimate the contribution to total costs of each section separately.

Even estimating the total costs of installing PTC requires some degree of speculation, as no entity is procuring PTC on the scale required by RSIA08, or on its aggressive installation timeline. In general, the less time an entity takes to make a major acquisition, the more it has to pay for it, because both supply elasticity and demand elasticity are lower with shorter timeframes. Further, any design difficulties will be exacerbated by the short timeframes. On the other hand, widespread acquisition of large number of units will allow development costs to be amortized over a large number of units, and the unit cost of development will be relatively lower, all else equal.

3.1 Seeking Further Comments

While the final rule is effective on the date indicated therein, FRA believes that certain issues warrant further discussion. Accordingly, FRA will continue to seek comments limited to increasing the clarity, certainty, and transparency of the criteria governing the removal from a PTCIP (and therefore from the requirement to install PTC) of any track segments on which PTC systems have yet to be installed for which a railroad seeks relief from the requirement to install PTC. FRA also seeks comments on how to measure the appropriate level of risk established in section 236.1005(b)(4)(i)(A)*(2)(iii)* to require the installation of PTC on lines not carrying PIH or passenger traffic. No railroad has supplied data supporting further track exceptions from PTC system installation consistent with statutory and safety requirements. Thus, FRA requests additional data to support commenters' positions. . FRA also seeks comment and information on ways that it might consider risk mitigations other than by a compensating extension of PTC or PTC technologies.

In § 236.1005(b)(4)(i), the final rule provides an exception to PTC system implementation where such implementation would provide only a de minimis PIH risk. While in the proposed rule FRA sought means to reduce the railroads' burdens associated with this rule, no specific de minimis exception was proposed. The AAR mentioned this possibility in its comment filed during the comment period and offered in supplementary comments filed after the comment period to work with FRA on this issue. FRA believes that the de minimis exception provided in this final rule falls within the scope of the issues set forth in the proposed rule. However, since none of the parties has had an opportunity to comment on this specific exception as provided in this final rule, FRA seeks comments on the extent of the de minimis exception.

As further explained below, the final rule uses 2008 traffic data as an initial baseline in each PTCIP to determine the breadth and scope of PTC system implementation and, in recognition of the fact that traffic patterns are likely to change to some degree before December 31, 2015, provides means of adjusting the track segments on which PTC must be installed where adjustments are appropriately justified. These issues relate to the potential scaling back of the breadth and scope of that baseline through the request by the railroads—made contemporaneously or subsequently to PTCIP submission and prior to actual PTC system implementation—on the subject track segments for FRA to apply certain regulatory exceptions. Under the procedures set forth in the final rule, requests for such amendments may be made after PTCIP submission. Since these issues should not affect the PTCIP required to be filed by the April 16, 2010, statutory deadline, FRA believes that time is available for some further consideration.

3.2 Use of Performance Standards

Given the statutory mandate for the implementation of PTC systems, FRA intends the final rule to accelerate the promotion of, and not hinder, cost effective technological innovation by encouraging an efficient utilization of resources, an increased level of competition, and more innovative user applications and technological developments. FRA believes that, wherever possible, regulation must allow technologies the full freedom to exploit market opportunities, must support the challenges and opportunities resulting from the combination of emerging and varying technologies within an evolving marketplace, and should not discriminate between PTC systems vendors due to the technology or services provided.

Accordingly, wherever possible FRA has refrained from developing technical or design standards, or even requiring implementation of particular PTC technologies that may prevent technological innovation or the development of alternative means to achieve the statutorily defined PTC functions. If FRA were to implement specific technical standards, emerging technologies may render those standards obsolete, but nevertheless required. Implementation of systems by the railroads using new technologies that are not addressed by the standards would require railroads and FRA to manage the deployment using a cumbersome and time consuming waiver process. For the same reasons FRA expressed in the final rule implementing subpart H (70 Fed. Reg. 11052, 11055-11059 (Mar. 7, 2005)), FRA continues to believe that it is best to pursue a performance-based standard while providing sufficient basic parameters within which the system's architectures and functionalities must be developed, implemented, and maintained.

Like subpart H, the new subpart I provides for the same level of product confidence and versatility in determining what PTC technology a railroad may elect to implement and operate, even if the railroad chooses to modify its PTC system over time. Unlike subpart H, however subpart I requires specific deployment of PTC while simplifying the application process, potentially reducing the size of the regulatory filings through facilitation of safety documentation reuse, and more narrowly defining the required performance targets based on railroad operations and in terms of more specific functional PTC behaviors. The approach under subpart I also reduces the likelihood of continually changing safety targets, which may vary based on each railroad's safety culture, and provides for incremental improvements in safety in coordination with FRA.

To ensure sufficient confidence in each PTC system implemented under subpart I, FRA expects that all safety- and risk-related data be supported by credible evidence or information. Such credible evidence or information may be developed through laboratory or field testing, augmented by appropriate analysis and inspection, which may be monitored or reviewed by FRA. FRA expects that as a practical matter, lab testing should be performed in the majority of cases. FRA does not believe it is necessary to require any railroad to lab test. However, field testing may be required in certain instances to test certain points of the PTC system in various conditions.

If the railroad or FRA determines that the complexity of the technology or the supporting safety case warrants, credibility of this information may also be evaluated through an assessment of Verification and Validation performed by an acceptable independent third party selected and paid for the railroad, subject to FRA approval. Ultimately, however, it is FRA's responsibility to determine whether each PTC system's performance results in an acceptable level of safety to railroad employees and the general public and whether any such system shall receive PTC System Certification, as required by statute.

In order to provide meaningful flexibility, FRA is prepared to consider use of alternative risk analysis methods and proposals regarding the extent to which a product exhibits fail-safe behavior. FRA still emphasizes that higher speed and higher risk rail service should be supported by more highly competent train control technology and analysis.

FRA recognizes that there may potentially be various PTC system configurations and a variety of operational scopes involved. FRA believes that the information requested under subpart I should be sufficient to permit FRA to predict whether the PTC system is fully adequate from a safety perspective. Subparts H and I require submission of similar technical data. Given the degree of uncertainty associated with the underlying analysis of a complex PTC system and its environs, subpart I—much like subpart H—requires application of FRA's judgment and expertise. Given the underlying analysis' complexity—and FRA's need to ensure an acceptable level of safety and analytical uniformity between functionally equivalent but architecturally different systems—it is incumbent upon the subject railroad, possibly in concert with the vendor, supplier, or manufacturer of its PTC system, to make a persuasive case in its filings that the applicable performance standards are met. Primarily, the risk assessments required by the final rule should provide an objective measure of the safety risk levels involved, which will be reviewed by FRA for comparison purposes. As such, FRA believes that each risk assessment should determine relative risk levels, rather than absolute risk levels, but against a clearly delineated base case acceptable to FRA under the final rule.

The primary goal of the risk assessment required by this rule is to give an objective measure of the levels of safety risk involved for comparison purposes. As such, FRA believes the focus of the risk assessment ought to be the determination of relative risk levels, rather than absolute risk levels. Thus, the final rule attempts to emphasize the determination of relative risk. FRA believes that the guidelines captured in Appendix B adequately state the objectives and major considerations of any risk assessment it would expect to see submitted per subpart I. FRA also feels that these guidelines allow sufficient flexibility in the conduct of risk assessments, yet provide sufficient uniformity by helping to ensure final results are presented in familiar units of measurement.

One of the major characteristics of a risk assessment is determined by the extent to which it is performed using qualitative and quantitative methods. FRA continues to believe that both quantitative and qualitative risk assessment methods may be used, as well as combinations of the two. FRA expects that qualitative methods should be used only where appropriate, and only when accompanied by an explanation as to why the particular risk cannot be fairly quantified. FRA also continues to believe that railroads and suppliers should not be limited in the type of risk assessments they should be allowed to perform to demonstrate compliance with the minimum performance standard. The state of the art of risk assessment methods could potentially change more quickly than the regulatory process will allow, and not taking advantage of these innovations could slow the progress of implementation of safer signal and train control systems. Thus, as in subpart H, FRA is allowing risk assessment methods not meeting the guidelines of this rule, so long as it can be demonstrated to the satisfaction of the FRA Associate Administrator for Railroad Safety/Chief Safety Officer (hereinafter Associate Administrator) that the risk assessment method used is suitable in the context of the particular PTC system. FRA believes this determination is best left to the Associate Administrator because the FRA retains authority to ultimately prevent implementation of a system whose plans do not adequately demonstrate compliance with the performance standard under the final rule.

FRA is aware that some types of risk are more amenable to measurement by using certain methods rather than others because of the type and amount of data available. If a railroad does elect to use different risk assessment methods, FRA will consider this as a factor for PTC System Certification (see § 236.1015). Also, in such cases, when the margin of uncertainty has been inadequately described, FRA will be more likely to require FRA monitored field or laboratory testing (see § 236.1035) or an independent third-party assessment (see § 236.1017).

When FRA issued the final rule establishing subpart H, FRA considered the criteria of simplicity, relevancy, reliability, cost, and objectivity. FRA believes that these criteria remain applicable. FRA has attempted to make the requirements under subpart I simpler than the requirements of subpart H, so that railroads will be provided with a greater deal of flexibility to more easily demonstrate that their PTC systems are certifiable by FRA. Like subpart H, subpart I focuses on the safety-relevant characteristics of systems and emphasizes all relevant aspects of product performance. FRA also drafted performance standards that can be applied reliably and precisely in a manner which should yield similar results each time it is applied to the same subject. Although RSIA08 appears to make cost a consideration secondary to safety, FRA believes that demonstrating compliance under subpart I should minimize those costs while not degrading the primary objective of public safety. FRA also believes that subpart I includes an objective performance standard where compliance can be determined through sound engineering analysis, testing, or investigation.

Although FRA generally prefers performance standards to specification standards, and has used a performance standard in the accompanying rulemaking, in this case, the preference is almost irrelevant, because FRA believes that it would not have been possible to develop a specification standard for PTC in the time allotted, and were such a standard developed, it would have been far more costly. Many of the provisions detailed below are those required to promulgate the performance standard. FRA gained significant experience in administering subpart H, and has, except where noted below, merely done what it can to transform a standard that could be applied if the railroad volunteered into a standard that could be applied in a mandatory program. The most obvious examples of this are minimum standards for what functions the systems must perform, and the level of safety at which these systems must perform those functions. Under subpart H there would not have been any problem implementing a system that performed just one of the core functions, as long as it yielded a net improvement in safety, but under subpart I it must perform all four core functions. Further, under subpart H it would have been acceptable to provide only a small improvement in safety, but under subpart I a system must either perform as well as a vital system or must yield an 80% reduction in risk. FRA believes that these standards are the least that would satisfy Congressional intent.

Another major difference in subpart I is the use of Type certification. Under subpart H each system would have needed approval on each railroad implementing it. Type approval has the potential to lessen that burden. FRA has learned from administering performance standards that it is not necessary to repeat proofs of performance on each railroad or line segment. This has become an issue in vehicle-track interaction standards under parts 213 and 238, and FRA is at present developing standards to ease that problem. The Type certification process will not add any new costs; it will probably reduce costs, make it easier to track PTC system performance across diverse railroads, and facilitate installation under the aggressive schedule mandated by RSIA08. The use of the Type certification process is optional, but FRA believes that any new systems will take advantage of such process.

FRA did not analyze either an option with a lesser performance standard such as simply proving that the new system is at least as safe as what it replaces, the current subpart H standard as it would not meet Congressional intent, nor an option that would not permit use of Type certification.

4. Section-by-Section Analysis

4.1 Section 229.135, Event Recorders

Advances in electronics and software technology have not only enabled the development of PTC systems, but have also resulted in changes to the implementation of locomotive control systems. These technological changes have provided for the introduction of new functional capabilities and the integration of different functions in ways that advance the building, operation, and maintenance of locomotive control systems. FRA also recognizes that advances in technology may further eliminate the traditional distinctions between locomotive control and train control functionalities. Indeed, technology advances may provide for opportunities for increased or improved functionalities in train control systems that run concurrent with locomotive control.

Train control and locomotive control, however, remain two fundamentally different operations with different objectives. FRA does not want to restrict the adoption of new locomotive control functions and technologies by imposing regulations on locomotive control systems intended to address safety issues associated with train control. Accordingly FRA is reviewing and enhancing the Locomotive Safety Standards (49 CFR part 229) to address the use of advanced electronics and software technologies to improve safe, efficient, and economical locomotive operations when a new or proposed locomotive control system function does not interfaces or comingles with a safety critical train control system. In the meantime, FRA is amending § 229.135 to ensure its applicability to subpart I. <u>The proposed amendment to the existing event recorder section of the Locomotive Safety Standards was intended to make that section parallel to the additions in § 236.1005(d) below. No comments were received, and the section is adopted as proposed</u>

FRA believes that existing event recorders and PTC non-volatile memory will have sufficient capability to perform the functions required by this section at no additional cost.

4.2 Section 234.275, Processor-Based Systems

Section 234.275 of title 49 currently requires that each new or novel technology used for active warning at highway-rail grade crossings be qualified using the subpart H process, including approval of a Product Safety Plan. Particularly with respect to high speed rail, FRA anticipates that PTC systems will in some cases incorporate new or novel technology to provide for crossing pre-starts (reducing the length of approach circuits for high speed trains), to verify crossing system health as between the wayside and approaching trains, or to slow trains approaching locations where storage has been detected on a crossing, among other options. Indeed, each of these functions is currently incorporated in at least one train control system, and others may one day be feasible (including in-vehicle warning). There would appear to be no reason why such a functionality intended for inclusion in a PTC system mandated by subpart I could not be qualified with the rest of the PTC system under subpart I. On the other hand, care should be taken to set an appropriate safety standard taking into consideration road users, occupants of the high speed trains, and others potentially affected.

In fact, with new emphasis on high speed rail, FRA needs to consider the ability of PTC systems to integrate this type of new technology and thereby reduce risk associated with high speed rail service. Risk includes derailment of a high speed train with catastrophic consequences after encountering an obstacle at a highway-rail grade crossing. To avoid such consequences, as many crossings as possible should be eliminated. To that end, 49 CFR § 213.347 requires a warning and barrier plan to be approved for Class 7 track (speeds above 110 mph) and prohibits grade crossings on Class 8 and 9 track (above 125 mph). That leaves significant exposure on Class 5 and 6 track that is currently not addressed by regulation.

At the public hearing in this proceeding, the RLO indicated its agreement with FRA's interpretation of 49 CFR § 213.347 and stated that significant exposure remains at highway-rail grade crossings for Class 5 and 6 track, because "such plans or prohibitions are not currently addressed by Federal Regulation." In addition to the proposed amendments to § 234.275, however, the RLO believes that PTC systems should also be mandated under subpart I to incorporate technology that would verify a highway-rail grade crossing warning system's activation for an approaching train and slow a train approaching a location where such system activation could not be verified. The RLO believes that such verification and speed restriction enforcement would significantly lower the exposure for a potential collision between a highway motor vehicle and a train. According to the RLO, this function is currently incorporated into at least one deployed train control system and is therefore feasible. In addition, the RLO propose that certain existing highway-rail grade crossing warning system regulations and requirements, including those in parts 213 and 234, and in subpart H to part 236, could be cross referenced or included in subpart I to ensure regulatory harmony.

While AAR has noted that it understands the safety concern, and has asserted that this function is not related to the core PTC functions mandated by Congress. Furthermore, according to AAR, the cost of installing wayside interface units at grade crossings on PTC routes would be prohibitively expensive and would divert resources that would otherwise be devoted to meeting the mandated PTC deadline.

The NTSB has recommended that the warning and barrier protection plans similar to those for Class 7 track at grade crossings in 49 CFR § 213.347 should also apply to Class 5 and 6 tracks. According to the NTSB, such protection at crossings (similar to protection at crossings afforded within the ITCS project) should be integrated as part of an approved PTC plan to reduce the risk of high-speed catastrophic derailments at such grade crossings.

FRA, while certainly recognizing these concerns, is not including further prescriptive requirements for highway-rail grade crossings beyond those set forth in § 214.347. FRA has separately developed Guidelines for Highway-Rail Grade Crossing Safety for high speed rail that will be employed in the grant review and negotiation process under the American Recovery and Reinvestment Act of 2009. The Guidelines encourage use of sealed corridor strategies for Emerging High Speed Rail systems and integration of highway-rail warning systems with PTC where feasible.

This section is permissive, and adds no costs.

4.3 Section 235.7, Changes Not Requiring Filing of Application

FRA is amending this section of the regulation which allows specified changes within existing signal or train control systems to be made without the necessity of filing an application. The amendment consists of adding allowance for a railroad to remove an intermittent automatic train stop system in conjunction with the implementation of a PTC system approved under subpart I of part 236. The changes allowable under this section, without filing of an application, are those identified on the basis that the resultant condition will be at least no less safe than the previous condition. The required functions of PTC within subpart I provide a considerably higher level of functionality related to both alerting and enforcing necessary operating limitations than an intermediate automatic train stop system does. Additionally, in the event of the loss of PTC functionality (i.e., a failure en route), the operating restrictions required will provide the needed level of safety in lieu of the railroad being expected to keep and maintain an underlying system such as intermittent automatic train stop for only in such cases. FRA therefore believes that with the implementation of PTC under the requirements of subpart I, the safety value of any previously existing intermittent automatic train stop system is entirely obviated. There were no objections in the PTC Working Group to this amendment.

The AAR submitted comment that within § 236.1021, paragraphs (j)(2) and (j)(3) should be revised to recognize the allowance for removal of a signal used in lieu of an electric or mechanical lock in the same manner as removal of the electric or mechanical lock. These two paragraphs are intended to recognize that where train speed over the switch does not exceed 20 miles per hour, or where trains are not permitted to clear the main track at such switch, removal of the devices intended to provide the necessary protection without filing for approval is appropriate.

The regulation requiring the installation of an electric or mechanical lock identifies the allowance for a signal used in lieu thereof (see § 236.410). FRA agrees with the AAR that when the requirement for an electric or mechanical lock, or a signal used in lieu thereof, are eliminated, the removal of any of these devices in their entirety without filing for approval is appropriate. FRA is therefore amending paragraphs (j)(2) and (j)(3) of § 236.1021 as recommended in order to clarify these allowances.

For the same reasoning and in a consistent manner, FRA is amending paragraphs (b)(2) and (b)(3) in existing § 235.7 in order to provide the same allowances for removal of a signal used in lieu of an electric or mechanical lock within block signal systems without filing for approval. This section avoids an unnecessary requirement for paperwork, and does not add to costs.

4.4 Section 236.0, Applicability, Minimum Requirements, and Penalties

FRA amends this existing section of the regulation to remove manual block from the methods of operation permitting speeds of 50 miles per hour or greater for freight trains and 60 miles per hour or greater for passenger trains. Manual block rules do create a reasonably secure means of preventing train collisions. However, the attributes of block signal systems are not present, leaving the potential for misaligned switches, broken rails or fouling equipment to cause a train accident. FRA believes that contemporary expectations for safe operations require this adjustment, which also provides a more orderly foundation for the application of PTC to the subject territories. There were no objections in the RSAC to this change.

In the interval between adoption of this provision and 2015 this might have applied to some passenger lines, however at the PTC Working Group, the affected railroads told FRA that they were eliminating this operation. The only affected railroads will be freight operations in manual block at speeds of 50 mph or greater. The costs of restricting train speed to 50 mph on a freight line would be minimal, and on most affected lines such restriction will be temporary since PTC will be installed by 2015. The benefits and costs of implementing this provision are negligible, especially in comparison to all of the other costs of implementing PTC systems.

After review of the NPRM, AAR stated that paragraph (c)(1)(ii)(A) seemed to preclude the operations identified in paragraph (c)(1)(ii)(B) and that it was unclear whether paragraph (c)(1)(ii)(A) applies to opposing trains or some other condition. Therefore, the AAR recommended that paragraphs (c)(1)(ii)(A) and (c)(1)(ii)(B) be revised. FRA agrees and has therefore revised paragraphs (c)(1)(ii)(A) and (c)(1)(ii)(B), and added paragraphs (c)(1)(ii)(C) and (c)(1)(ii)(D), in the final rule to improve clarity. These changes do not affect the benefits or costs of the rule.

FRA has also added paragraph (d)(2) in the final rule to address the use of automatic cab signal, automatic train stop, or automatic train control systems on or after December 31, 2015. On or after December 31, 2015, the method of protecting high-speed train operations will be through the use of PTC. FRA recognizes that there may be justifiable reasons for continued use of automatic cab signal, automatic train stop, or automatic train control systems on or after December 31, 2015 on certain lines, where the installation of PTC would be inappropriate. In situations where the automatic cab signal, automatic train stop, or automatic train control systems are an integral part of the PTC system design, no action will be required by a railroad. In any other situation, however, FRA will only allow continued use of an automatic cab signal, automatic train stop, or automatic train control system on a case-by-case basis after sufficient justification has been provided to the Associate Administrator. FRA believes that the costs and benefits of this provision were included in the analysis of the NPRM, and have not changed in the final rule.

FRA has also added a preemption provision at the end of section 236.0. Part 236, which FRA inherited from the Interstate Commerce Commission at the time FRA was created, has had preemptive effect by operation of law at least since enactment of the Federal Railroad Safety Act of 1970 (P.L. 111-43). However, no preemption provision was ever added, largely as an historical accident. Since enactment of the Implementing Recommendations of the 9/11 Commission Act of 2007 (9/11 Commission Act of 2007), Pub. L. 110-53, which amended 49 U.S.C. 20106 significantly, FRA has been updating the preemption provisions of its regulations to conform to the current statute as opportunities to do so are presented. New subsection 236.0(i) is added to accomplish that and to recite the preemptive effect of the Locomotive Boiler Inspection Act (49 U.S.C. 20701-20703), which has been held by the U.S. Supreme Court to preempt the entire field of locomotive safety; therefore, this part preempts any state law, including common law, covering the design, construction, or material of any part of or appurtenance to a locomotive.

The text of section 236.0(i)(1) and (2) directly reflects FRA's interpretation of 49 U.S.C. 20106, as amended. Read by itself, 49 U.S.C. 20106(a) preempts state standards of care, including common law standards, Norfolk Southern Ry. v. Shanklin, 529 U.S. 344, 358-359 (2000), CSX Transp., Inc. v. Easterwood, 507 U.S. 658, 664 (1993), but does not expressly state whether anything replaces the preempted standards of care for purposes of tort suits. The focus of that provision is clearly on who regulates railroad safety: the federal government or the states. It is about improving railroad safety, for which Congress deems nationally uniform standards to be necessary in the great majority of cases. That purpose has collateral consequences for tort law which new statutory section 20106 paragraphs (b) and (c) address. New paragraph (b)(1) creates three exceptions to the possible consequences flowing from paragraph (a). One of those exceptions (paragraph (b)(1)(B)) precisely addresses an issue presented in Lundeen v. Canadian Pacific Ry., 507 F.Supp.2d 1006 (D.Minn. 2007) that Congress wished to rectify: it allows plaintiffs to sue a railroad in tort for violation of its own plan, rule, or standard that it created pursuant to a regulation or order issued by either of the secretaries. None of those exceptions covers a plan, rule, or standard that a regulated entity creates for itself in order to produce a higher level of safety than federal law requires, and such plans, rules, or standards were not at issue in Lundeen. The key concept of section 20106(b) is permitting actions under state law seeking damages for personal injury, death, or property damage to proceed using a federal standard of care. A plan, rule, or standard that a regulated entity creates pursuant to a federal regulation logically fits the paradigm of a federal standard of care—federal law requires it and determines its adequacy. A plan, rule, or standard, or portions of one, that a regulated entity creates on its own in order to exceed the requirements of federal law does not fit the paradigm of a federal standard of care—federal law does not require that the law be surpassed and, past the point at which the requirements of federal law are satisfied, says nothing about its adequacy. That is why FRA believes that section 20106(b)(1)(B) covers the former, but not the latter. The basic purpose of the statute—improving railroad safety—is best served by encouraging regulated entities to do more than the law requires and would be disserved by increasing potential tort liability of regulated entities that choose to exceed federal standards, which would discourage them from ever exceeding federal standards again.

In this manner, Congress adroitly preserved its policy of national uniformity of railroad safety regulation expressed in section 20106(a)(1) and assured plaintiffs in tort cases involving railroads, such as Lundeen, of their ability to pursue their cases by clarifying that federal railroad safety regulations preempt the standard of care, not the underlying causes of action in tort. Under this interpretation, all parts of the statute are given meanings that work together effectively and serve the safety purposes of the statute. The preemption provisions do not in themselves create any new benefits or costs, however, they preclude any unforeseen conflicts with state or local regulatory agencies that might attempt to add their own PTC or signal requirements to those of the final rule. Nothing in the preemption provisions prevents a state or local government, procuring or operating its own trains or service, from requiring additional equipment by contract.

4.5 Section 236.410, Locking, Hand-Operated Switch; Requirements

In this final rule, FRA is removing the Notes following paragraphs (b) and (c) of this section.

During FRA's review of the requirements contained in this Part, FRA discovered that the Note following paragraph (b), which had previously been removed as part of FRA's 1984 amendments to this Part, was inadvertently reprinted in the rule text several years later. As reflected in the preamble discussion of the 1983 proposed rule, FRA moved the provisions for removal of electric or mechanical locks to § 235.7 based on FRA's determination that the industry was capable of achieving compliance of train operations in procedures more suitable to individual properties.

In addition, FRA would like to remove the Note following paragraph (c), as this Note is no longer necessary. This Note, which was added in January 1984, required carriers to bring existing switches that were previously "grandfathered" on the basis of pre-1950 installation and switches that were installed on tracks that carriers had denominated auxiliary track into compliance with the requirements of this section within a three-year period.

In light of the history of this section, FRA is taking the opportunity within this rulemaking to remove the Note following paragraph (b), which presents information in conflict with the allowances that have been added into §§ 235.7(b)(2) and (b)(3). In addition, FRA is removing the Note following paragraph (c), as the required deadlines set forth therein have long since passed. This provision is a technical correction and has no benefits or costs.

4.6 Section 236.909, Minimum Performance Standard

FRA is modifying existing § 236.909 to make the risk metric sensitivity analysis an integral part of the full risk assessment required to be submitted with a product safety plan in accordance with § 236.907(a)(7). Paragraph (e)(2) of this section is also being modified to eliminate an alternative option for a railroad to use a risk metric in which consequences of potential accidents are measured strictly in terms of fatalities.

Prior to the modification of this section, paragraph (e)(1) discussed how safety and risk should be measured for the full risk assessment, but did not accentuate the need for running a sensitivity analysis on chosen risk metrics to ensure that the worst case scenarios for the proposed system failures or malfunctions are accounted for in the risk assessment. On the other hand, Appendix B to this part mandates that each risk metric for the proposed product must be expressed with an upper bound, as estimated with a sensitivity analysis. The FRA's experience gained while reviewing PSP documents required by Subpart H of this part and submitted to FRA for approval revealed that railroads did not consider it mandatory to run a sensitivity analysis for the chosen risk metrics. Thus, an additional effort was required from the FRA officials reviewing PSP submittals to demonstrate to the railroads the validity and significance of such a request. Therefore, this final rule amends paragraph (e)(1) to explicitly require the performance of a sensitivity analysis for the chosen risk metrics. The language in paragraph (e)(1) of this section explains why the sensitivity analysis is needed and what key input parameters must be analyzed.

FRA received comments on the proposed modification to paragraph (e)(1) of this section. While the RLO expressed support for making the risk metric sensitivity analysis an integral part of the full risk assessment, GE sought clarification and a sample regarding the proposed amendment to the clause regarding the risk assessment sensitivity analysis. GE believes that a literal interpretation of this clause would mean that the risk analysis must evaluate the risk sensitivity to variations in every individual electronic and mechanical component of the system. If so interpreted, GE asserts that the combinatorial calculations would present a significant barrier to the safety analysis and delay PTC system approval. GE further asserts that safety coverage of discrete component failures can be assured through other techniques in the overall system design. GE believes that the intent of this rule is that "component" should mean "functional subsystem," as system safety can be completely addressed by performing the sensitivity analysis at that level. Accordingly, GE proffers that paragraph (e)(1) of this section should be modified to allow the level of detail of the risk analysis to be chosen based on the system safety philosophy and technology chosen.

Similar concerns were expressed by HCRQ/CGI, who questioned the need for an additional requirement in the rule that would require the sensitivity analysis to document the sensitivity to worst case failure scenarios. In the alternative, HCRQ/CGI suggested that the final rule should require a reasonable justification for all failure rates.

In response to these comments, FRA would like to clarify that the lowest level of system elements constructing the overall system that would be subject to risk analysis and the following sensitivity analysis are "components," "modules," "pieces of equipment," or "subsystems" that are processor-based in nature, the functionality and performance of which are governed by this part. FRA declines, however, to provide a sample sensitivity analysis in this rulemaking document, as the technique of sensitivity analysis has been well covered by a number of system safety engineering studies.

FRA notes that the term, "worst case failure scenario" is a subject of general theory of system safety and reliability. Therefore, it does not appear to be necessary to provide an interpretation of this term. Nonetheless, in response to comments that have been received on this issue, FRA would like to add a clarifying statement. A sensitivity analysis must be conducted by defining the range of values (i.e., lower bound, upper bound, and associated distribution) for key input parameters and assessing the impact of variations over those ranges on the overall system risk. The worst case analysis must consider realistic combinations of the key input parameters as they tend toward their worst case values. Justification must be provided for the ranges and process used in the design of the sensitivity analysis.

Another comment from HCRQ/CGI relates to the requirement that "the sensitivity analysis must confirm that the risk metrics of the system are not negatively affected by sensitivity analysis input parameters…." HCRQ/CGI requested that the meaning of the phrase "negatively affected" be specified. FRA agreed to provide such an explanation and therefore offered an interpretation of the words "negatively affected" in paragraph (e)(1).

The modification to paragraph (e)(2) is intended to clarify how the exposure and its consequences, as main components of the risk computation formula, must be measured. Under the final rule, the exposure must be measured in train miles per year over the relevant railroad infrastructure where a proposed system is to be implemented. When determining the consequences of potential accidents, the railroad must identify the total costs involved, including those relating to fatalities, injuries, property damage, and other incidentals. The final rule eliminates the option of using an alternative risk metric, which would allow the measurement of consequences strictly in terms of fatalities. It is FRA's experience that measuring consequences of accidents strictly in term of fatalities did not serve as an adequate alternative to metrics of total cost of accidents for two main reasons. First, the statistical data on railroad accidents shows that accidents involving fatalities also cause injuries and significant damage to railroad property and infrastructure for both freight and especially passenger operations. Even though the cost of human life is always the highest component of monitory estimates of accident consequences, the dollar estimates of injuries, property losses, and damage to the environment associated with accidents involving fatalities cannot and should not be discounted in the risk analysis. Second, allowing fatalities to serve as the only risk metric of accident consequences confused the industry and the risk assessment analysts attempting to determine the overall risk associated with the use of certain types of train control systems. As a result, some risk analysts inappropriately converted injuries and property damages for observed accidents into relative estimates of fatalities. This method cannot be considered acceptable because, while distorting the overall picture of accident consequences, it also raises questions on appropriateness of conversion coefficients. Therefore, FRA considers it appropriate to eliminate from the rule the alternative option for consequences to be measured in fatalities only. This approach gained the support of the RLO, who in their comments concur with a modification of paragraph (e)(2) that is eliminating an option of risk consequences to be measured in fatalities only.

FRA does not believe that any railroads intended to use fatalities alone as a risk metric. FRA has seen some draft risk assessments where monetized costs were converted into fatality equivalents, defeating the original intent and value of having a single metric. This change is not expected to impact railroads.

4.7 Section 236.1001, Purpose and Scope

This section describes both the purpose and the scope of subpart I. Subpart I provides performance-based regulations for the development, test, installation, and maintenance of PTC systems, and the associated personnel training requirements, that are mandated for installation by the FRA.

A number of railroads indicated concern with a potentially significant reprogramming of funds due to the statutorily mandated implementation of PTC systems. These railroads claim that the costs associated with PTC system implementation will lead to deferred capital improvements and maintenance elsewhere in the general railroad system, including degraded track, bridge, or drainage conditions, which may then lead to accidents. Thus, according to these railroads, the mandated PTC implementation, within an extremely aggressive timeframe, may lead to an overall reduced level of safety. FRA recognizes that the cost of PTC will be substantial. FRA does note that capital expenditures can often be financed; and the Railroad Rehabilitation and Improvement Financing (RRIF) program is one source of such financing. Other potential sources include private financing, public bond authority, and State and Federal appropriations. It is the responsibility of each public and private railroad to determine appropriate funding sources to meet its needs. For purposes of his analysis, it does not matter who pays for PTC, as shifting such costs, amounts to no more than arranging transfer payments. However, to the extent that such costs are passed on to shippers by railroads, and the shippers change their choice of mode of transportation for a given shipment, the shift between modes may occasion societal costs or benefits. This is a key implication of the business benefits model, in Appendix A, but is not a factor in the main analysis.

Various railroads also urge FRA to not use its discretion to require more than the minimum mandated by RSIA08. These railroads note that under FRA's economic analysis of the NPRM, the costs of PTC implementation would have outweighed its benefits by a ratio of 15 to 1, while using the more conservative numbers in this analysis of the final rule, the costs may outweigh benefits by a ration between 20:1 and 22:1. While these railroads acknowledge that these costs are mostly unavoidable due to the Congressional mandate, they believe that there are ways FRA may mitigate these and other costs associated with this rule. FRA has in fact crafted this final rule to limit the cost of implementation and to avoid further PTC development that could require additional funding and additional time. Accordingly, in the proposed and final rule FRA has indicated a willingness to approve suitable systems employing non-vital on-board processing, to recognize signal logic as an appropriate means of protecting movements over switches, to recognize systems that enforce the upper limit of restricted speed as suitable collision avoidance in the case of following trains and joint authorities, to avoid any requirements for monitoring of derails off the main line in conventional speed territory, to allow for conventional arrangements at diamond crossings where speeds are moderate, and to recognize to the maximum extent possible safety case showings made prior to the effective date of this rule under subpart H. In addition, FRA has made generous allowances for operation of Class II and III locomotives in PTC territory and significant "main line" exceptions for passenger routes. Together these actions will save the railroads billions of dollars of initial expense, as well as continuing expense in maintenance over the coming years.

4.8 Section 236.1003, Definitions

Given that a natural language such as English contains, at any given time, a finite number of words, any comprehensive list of definitions must either be circular or leave some terms undefined. In some cases, it is not possible and indeed not necessary to state a definition; rather, one simply comes to understand the use of the term. Where possible and practicable, FRA prefers to provide explicit definitions for terms and concepts rather than rely solely on a shared understanding of a term through use.

Paragraph (a) reinforces the applicability of existing definitions of subparts A through H. The definitions of subparts A through H are applicable to subpart I, unless otherwise modified by this part.

Paragraph (b) introduces definitions for a number of terms that have specific meanings within the context of subpart I.

While definitions are important to understanding a rule, they have no regulatory force by themselves, and therefore neither add benefits, nor costs.

4.9 Section 236.1005, Requirements for Positive Train Control Systems

RSIA08 specifically requires that each PTC system be designed to prevent train-to-train collisions, overspeed derailments, incursions into established work zone limits, and the movement of a train through a switch left in the wrong position. Section 236.1005 includes the minimum statutory requirements and provides amplifying information defining the necessary PTC functions and the situations under which PTC systems must be installed. Each PTC system must be reliable and perform the functions specified in RSIA08.

Train-to-train collisions. Paragraph (a)(1)(I) applies the statutory requirement that a mandatory PTC system must be designed to prevent train-to-train collisions. At this time, FRA understands this to mean head-to-head, rear-end, and side and raking collisions between trains on the same, converging, or intersecting tracks. Currently available PTC technology can meet these needs by providing current and continuous guidance to the locomotive engineer and enforcement using predictive braking to stop short of known targets. FRA notes that the technology associated with currently available PTC systems may not completely eliminate all collisions risks. For instance, a PTC system mandated by this subpart is not required to prevent a collision caused by a train that derails and moves onto a neighboring or adjacent track (known in common parlance as a "secondary collision").

During discussions regarding available PTC technology, it has been noted that this technology also has inherent limitations with respect to prevention of certain collisions that might occur at restricted speed. In signal territory, there are circumstances under which trains may pass red signals, other than absolute signals, either at restricted speed or after stopping and then proceeding at restricted speed. To avoid rear end collisions, available PTC technology does not track the rear end of each train as a target but instead relies on the signal system to indicate the appropriate action. In this example, the PTC system would display "restricted speed" to the locomotive engineer as the action required and would enforce the upper limit of restricted speed (i.e., 15 or 20 miles per hour, depending on the railroad). This means that more serious rear end collisions will be prevented, because the upper limit of speed is enforced, and it also means that fewer low speed rear-end collisions will occur because a continuous reminder of the required action will be displayed to the locomotive engineer (rather than the engineer relying on the aspect displayed by the last signal, which may have been passed some time ago). However, some potential for a low-speed rear-end collision will remain in these cases, and the rule is clear that this limitation will be accepted. Similar exposure may occur in non-signaled territory where trains are conducting switching operations or other activities under joint authorities. The PTC system can enforce the limits of the authority and the upper limit of restricted speed, but it cannot guarantee that the trains sharing the authority will not collide. Again, however, the likelihood and average severity of any potential collisions would be greatly reduced. FRA may address this issue in a later modification to subpart I if necessary as technology becomes available.

FRA received comments on this discussion of the inherent limitations of available PTC technology with respect to the prevention of certain collisions that may occur at restricted speed from the New York State Metropolitan Transportation Authority (NYSMTA). NYSMTA sought clarification that PTC is not intended to enforce conformance of block entry speeds associated with wayside signal aspects or similar cab signal aspects provided without speed control, except when a train is operating under a wayside signal or cab signal aspect requiring a speed not to exceed restricted speed. FRA noted in the NPRM, and repeats here, that FRA recognizes that some PTC architectures will not directly enforce speed restrictions imposed by all intermediate signals. FRA does expect that the PTCDP will be clear on how the system accomplishes train separation and regulation of speeds over turnouts.

The final rule text, however, does provide an example of a potential train-to-train collision that a PTC system should be designed to prevent. Rail-to-rail crossings-at-grade—otherwise known as diamond crossings—present a risk of side collisions. FRA recognizes that such intersecting lines may or may not require PTC system implementation and operation. Since a train operating with an unregulated PTC system cannot necessarily recognize a train not operating with a PTC system or moving on an intersecting track without a PTC system, the PTC system—no matter how intelligent—may not be able to prevent a train-to-train collision in such circumstances.

Accordingly, paragraph (a)(1)(i) requires certain protections for such rail-to-rail crossings-at-grade. While these locations are specifically referenced in paragraph (a)(1)(i), their inclusion is merely illustrative and does not necessarily preclude any other type of potential train-to-train collision. Moreover, a host railroad may have alternative arrangements to the specific protections referenced in the associated table under paragraph (a)(1)(i), which it must submit in its PTC Implementation Plan (PTCIP)—discussed in detail below—and receive a PTC System Certification associated with that PTCIP.

Rail-to-rail crossings-at-grade that have one or more PTC routes intersecting with one or more routes without a PTC system must have an interlocking signal arrangement in place developed in accordance with subparts A through G of part 236 and a PTC enforced stop on all PTC routes.

FRA has also determined that the level of risk varies based upon the speeds at which the trains operate through such crossings, as well as the presence, or lack, of PTC equipped lines leading into the crossing. Accordingly, under a compromise accepted by the PTC Working Group, if the maximum speed on at least one of the intersecting tracks is more than 40 miles per hour, then the routes without a PTC system must also have either some type of positive stop enforcement or a split-point derail on each approach to the crossing and incorporated into the signal system, and a permanent maximum speed limit of 20 miles per hour. FRA expects that these protections be instituted as far in advance of the crossing as is necessary to stop the encroaching train from entering the crossing. The 40 miles per hour threshold appears to be appropriate given three factors. First, the frequency of collisions at these rail intersections is low, because typically one of the routes is favored on a regular basis and train crews expect delays until signals clear for their movement. Second, the special track structure used at these intersections, known as crossing diamonds, experiences heavy wear; and railroads tend to limit speeds over these locations to no more than 40 miles per hour.

Finally, FRA recognizes that for a train on either intersecting route, elevated speed will translate into higher kinetic energy available to do damage in a collision-induced derailment. Thus, for the relatively small number of rail crossings with one or more routes having an authorized train speed above 40 miles per hour, including higher speed passenger routes, it is particularly important that any collision be prevented. FRA believes that these more aggressive measures are required to ensure train safety in the event the engineer does not stop a train before reaching the crossing when the engineer does not have a cleared route displayed by the interlocking signal system and higher speed operations are possible on the route intersected. The split-point derail would prevent a collision in such a case by derailing the offending train onto the ground before it reaches the crossing. Should the train encounter a split-point derail as a result of the crew's failure to observe the signal indication, the slower speed at which the unequipped train is required to travel would minimize the damage to the unequipped train and the potential affect on the surrounding area. As an alternative to split-point derails, the non-PTC line may be outfitted with some other mechanism that ensures a positive stop of the unequipped crossing train. If a PTC system or systems are installed and operated on all crossing lines, there are no speed restrictions other than those that might be enforced as part of a civil or temporary speed restriction. However, the crossing must be interlocked and the PTC system or systems must ensure that each of the crossing trains can be brought safely to a stop before reaching the crossing in the event that another train is already cleared through or occupying the crossing.

The RLO share FRA's concerns regarding diamond crossings, supporting the requirements for interlocking signal arrangements, a PTC enforced stop on PTC routes, and installation of split-point derails with a 20 miles per hour maximum authorized speed on the approach of any intersecting non-PTC route. However, the RLO believe that split point derails should be required regardless of the PTC route's maximum speed in order to protect the PTC route against a non-equipped train passing through a stop indication and equipment inadvertently rolling out (i.e., a roll away) from the non-PTC route.

AAR and CSXT challenge the imposition of split-point derails. CSXT believes that the proposed rule merely shifts the safety risks associated with Class II and III railroads, but does not eliminate them altogether. For instance, CSXT points out that unlike a PTC-compliant system, the split-point derail would not avoid derailment altogether; rather, it would simply cause the non-PTC Class II or III train to derail away from the crossing. According to CSXT, the most comprehensive safety regime that would avoid both collisions and derailments would be to require Class II and Class III railroads operating on PTC routes also to be PTC equipped.

One commenter objected to the costs of derails being borne by PTC equipped Class I railroads. The NPRM did not purport to address who would pay this cost, but merely recited in a brief reference that the assumption had been made in the Initial Regulatory Flexibility Analysis that the railroad installing PTC would bear the cost. FRA does not stipulate who is responsible for the cost of split point derails at rail-to-rail crossings at-grade, as the cost will be borne in conformance with any agreements between the railroads or prior rights arising out of previous transactions under which property was acquired. FRA would have appreciated some indication of how those costs are likely to fall, but no information was provided on this point.

The commenter also proposes exploration of lower-cost alternatives in lieu of split point derails. FRA agrees that less expensive alternatives to split point derails at rail-to-rail crossings at-grade can and should be proposed in a railroad's PTCIP or PTCDP. As FRA stated in the preamble discussion of paragraph (a)(1)(i) in the proposed rule, "…the non PTC line may be outfitted with some other mechanism that ensures a positive stop of the unequipped … train." (74 Fed. Reg. 35950, 35960). FRA expects, however, that any alternative to the split point derail will provide the same level of separation as that afforded by the installation of the split-point derail.

CSX submitted comments stating that the installation of split-point derails would create a new danger, including a secondary collision. However, FRA believes that these aggressive measures at locations where train speeds exceed 40 miles per hour through rail-to-rail crossings at-grade , where not all routes have not been equipped with a PTC system or positive stop enforcement, are necessary in order to ensure train safety. FRA fully agrees that other than full PTC technology that provides positive stop enforcement is a more desirable method of protecting such locations. However, where such technology has not been installed, the prescribed use of split-point derails in approach to the crossing-at-grade is deemed necessary in the event the engineer of a train operating on a line without positive stop enforcement does not have a cleared route and fails to stop the train prior to reaching the crossing. The split-point derail, in combination with the required speed limitation of 20 miles per hour or less, would prevent a collision by derailing the offending train onto the ground before it reached the crossing. Should such a train encounter a split-point derail in its derailing position as a result of the crew's failure to observe or adhere to the signal indication, the slower speed at which an unequipped train is required to travel would minimize damage to the unequipped train and the potential effect on the surrounding area.

FRA has also considered the comments of the RLO that more secure arrangements should be provided at each rail-rail crossing, regardless of speed. FRA believes that where the PTC-equipped and non-PTC-equipped lines of the Class I railroads intersect, the railroads will generally utilize the available PTC technology to ensure a positive stop short of the crossing for any train required to stop short of the interlocking. The Wayside Interface Unit (WIU) at the location and available on-board capability supported by a radio data link should make this an obvious solution. FRA will scrutinize Class I PTCDPs to ensure that his is the case. FRA remains concerned that more aggressive solutions for intersections with Class II and III lines could impose substantial costs without returning significant benefits.

The costs and benefits of collision avoidance are included in the general cost and benefit sections presented below. The impacts of provisions regarding collision avoidance at at-grade crossings are included there as well. FRA acknowledges that those provisions have costs and benefits, but FRA believes that they are attributable to RSIA08. RSIA08 requires installation of PTC which prevents train-to-train collisions, and while FRA believes that it was not Congressional intent to regulate those collisions resulting from a train on one track derailing and fouling an adjacent track, FRA does believe that Congress, although not explicitly saying whether it did or did not intend the PTC systems to avoid collisions on at-grade crossings, intended to reduce train-to-train collisions occurring on at-grade crossings. FRA has merely described what avoidance of collisions entails.

Overspeed derailments. Paragraph (a)(1)(ii) requires that PTC systems mandated under subpart I be designed to prevent overspeed derailments and addresses specialized requirements associated with such provision. FRA notes that a number of passenger accidents with significant numbers of casualties have been caused by trains exceeding the maximum allowable speed at turnouts and crossovers and upon entering stations. Accordingly, FRA emphasizes the importance of enforcement of turnout and crossover speed restrictions, as well as civil speed restrictions. For instance, in the Chicago region, two serious train accidents occurred on the same Metra commuter line when locomotive engineers operated trains at more than 60 miles per hour while traversing between tracks using crossovers, which were designed to be safely traversed at 10 miles per hour.

For illustrative purposes, the rule text makes clear that such derailments may be related to railroad civil engineering speed restrictions, slow orders, and excessive speeds over switches and through turnouts and these type speed restrictions are to be enforced by the system.

The UTA and APTA each submitted the same basic comment pertaining to paragraph (a)(1)(ii), with which SCRRA concurred. They contend that speed restrictions are often set at a speed that is far below a speed that would cause a derailment. Therefore, they request that a PTC system should allow or display a speed higher than the actual speed restriction, but well short of a speed that may cause a derailment.

FRA is aware of various train control systems that have a 3 miles per hour tolerance before the system displays a warning to the train operator and that apply a penalty brake application at 5 miles per hour above the posted speed restriction. Appropriate speed margins or leeways associated with maximum authorized speed are expected, but they must be presented, justified, and approved within the context of a railroad's PTCDP and PTCSP.

The RLO submitted a comment noting that, while the language "prevent overspeed derailments" accurately reflects the language found in RSIA08, this paragraph misses the Congressional intent of the statute and appears to be unenforceable unless a derailment occurs in conjunction with a PTC system that fails to enforce an overspeed event. The RLO believe that FRA should amend this paragraph to establish that it will be a violation of this section if the PTC system fails to enforce an overspeed condition that is not corrected by the locomotive engineer regardless of whether or not such overspeed results in a derailment. Since most overspeed occurrences do not result in a derailment, the RLO asserts that waiting for a derailment to happen before declaring that the PTC system is not operating as intended is contrary to the purpose of the law.

FRA intends and believes that the PTC core feature concerning "overspeed derailments" is such that the system shall enforce various speed restrictions (i.e., civil speed restrictions, temporary slow orders, excessive speeds over switches and through turnouts and crossovers, etc.) regardless of whether a derailment actually occurs. However, FRA elects to leave the rule text of paragraph (a)(1)(ii) as it was written in the proposed rule.

The costs and benefits of preventing overspeed derailments are included in the general analysis of costs and benefits below.

Roadway work zones. Paragraph (a)(1)(iii) requires that PTC systems mandated under subpart I be designed to prevent incursions into established work zone limits. Work zone limits are defined by time and space. The length of time a work zone limit is applicable is determined by human elements. Working limits are obtained by contacting the train dispatcher, who will confirm an authority only after it has been transmitted to the PTC server. Paragraph (a)(1)(iii) emphasizes the importance of the PTC systems to provide positive protection for roadway workers working within the limits of their work zone.

Accordingly, once a work zone limit has been established, the PTC system must be notified. The PTC system must continue to enforce that limit until it is notified by the dispatcher or roadway worker in charge, with verification from the other, either that the limit is released and the train is authorized to enter or the roadway worker in charge authorizes movement of the train through the work zone.

To achieve this technological functionality, FRA's Office of Railroad Development has funded the development of a Roadway Worker Employee in Charge (EIC) Portable Terminal that allows the EIC to control the entry of trains into the work zone. While no rule includes the commonly used term EIC, FRA recognizes that it is the equivalent to the "Roadway Worker In Charge" as used in part 214. With the portable terminal, the EIC can directly control the entry of trains into the work zone and restrict the speed of the train through the work zone. If the EIC does not grant authority for the train to enter the work zone, the train is enforced to a stop prior to violating the work zone authority limits. If the EIC authorizes entry of the train into the work zone, the EIC may establish a maximum operating speed for the train consistent with the safety of the roadway work employees. This speed is then enforced on the train authorized to enter and pass through the work zone. The technology required for this terminal is significantly less complex than the technology associated with dispatching systems and the PTC onboard system. In view of this, FRA strongly encourages deployment of such portable terminals as opposed to current approaches which only require the locomotive engineer to in some manner "acknowledge" his authority to operate into or through the limits of the work zone (e.g., by pressing a soft key on the onboard display).

Pending the adoption of more secure technology such as the EIC Portable Terminal, FRA will scrutinize PTC Safety Plans to determine that they leave no opportunity for single point human failure in the enforcement of work zone limits. FRA notes that some approaches in the past have provided that the locomotive engineer could simply acknowledge a work zone warning, even if inappropriately, after which ,the train could proceed into the work zone. FRA requires that more secure procedures be included in safety plans under new subpart I.

The RLO submitted a comment that, in order for a PTC system to effectively perform the core function of protecting roadway workers operating within the limits of their authority, the PTC system must be designed in a manner that prevents override of an enforced stop prior to entering an established work zone through simple acknowledgement of the existence of work zone limits by a member of the train crew (i.e., by pressing a soft key on the onboard display, even if in error.). The RLO expressed support for FRA's intention to closely scrutinize PTC Safety Plans to determine whether they leave any opportunity for a single point human failure in the enforcement of work limits. The RLO strongly encouraged FRA to withhold approval of any PTC system that does not enforce a positive stop at the entrance to established work zones until notified directly by the dispatcher or the roadway worker in charge, with verification from the other, that the movement into the work zone has been authorized by the roadway worker in charge.

FRA agrees with the concern expressed by the RLO on this issue. However, in the spirit of staying strictly within the mandate of the RSIA08 related to required PTC functionality, FRA will require that the actual method of enforcement and acknowledgement associated with work zones be presented within the PTCDP and PTCSP and subject to FRA approval. FRA continues to strongly encourage use of EIC portable terminals with electronic handshake of acknowledgement and authorizations to enter work zones.

The costs and benefits of protecting roadway work zones are included in the general analysis of costs and benefits below. As with the costs and benefits associated with implementation of the collision avoidance and over-speed aspects, the costs and benefits associated with implementation of work zone protection are attributable to RSIA08.

Movement over main line switches. Paragraph (a)(1)(iv) requires that PTC systems mandated under subpart I be designed to prevent the movement of a train through a main line switch in the improper position. Given the complicated nature of switches—especially when operating in concert with wayside, cab, or other similar signal systems—the final rule provides more specific requirements in paragraph (e) as discussed further below.

In numerous paragraphs, the final rule requires various operating requirements based primarily on signal indications. Generally, these indications are communicated to the locomotive engineer, who is then expected to operate the train in accordance with the indications and authorities provided. However, a technology that receives the same information does not necessarily have the wherewithal to respond unless it is programmed to do so. Thus, paragraph (a)(2) requires PTC systems implemented under subpart I to obey and enforce all such indications and authorities provided by these safety-critical underlying systems. The integration of the delivery of the indication or authority with the PTC system's response to those communications must be described and justified in the PTC Development Plan (PTCDP)—further described below—and the PTCSP, as applicable, and then must comply with those descriptions and justifications. Again, FRA recognizes that in the case of intermediate signals, this may not involve direct enforcement of the signal indication.

APTA submitted a comment that the draft language of paragraph (a)(2) appears to disallow systems such as moving block overlays that may provide superior service. Since APTA does not believe this was the intent of the provision, APTA suggests that FRA clarify the language in this paragraph.

As FRA explained in the proposed rule, paragraph (a)(2) requires that PTC systems implemented under this subpart obey and enforce all indications and authorities provided by these safety-critical underlying systems. The integration of the delivery of the indication or authority with the PTC system's response to those communications must be described and justified in the railroad's PTCDP or PTCSP, as applicable. The PTC system must then comply with the descriptions and justifications contained within an FRA-approved PTCDP or PTCSP. Paragraph (a)(2) is clear that the specified functions must be performed "except as justified" in the PTCDP or PTCSP.

FRA specifically intends by so providing to afford a means by which advanced systems permitting moving block operations could be qualified, either as standalone systems or as overlays integrated with the existing signal and train control arrangements.

The PTC Working Group had extensive discussions concerning the monitoring of main line switches and came to the following general conclusions:

First, signal systems do a good job of monitoring switch position, and enforcement of restrictions imposed in accordance with the signal system is the best approach within signal territory (main track and controlled sidings). As a general rule, the enforcement required for crossovers, junctions and entry into and departure from controlled sidings will be a positive stop, and the enforcement provided for other switches (providing access to industry tracks and non-signaled sidings and auxiliary tracks) will be display and enforcement of restricted speed. NTSB representatives were asked to evaluate whether this strategy meets the needs of safety from their perspective. They returned with a list of accidents caused by misaligned switches that the Board had investigated in recent years, none of which was in signal territory.

In a filing in this proceeding, the Board indicated that switch monitoring in both dark and signal territories must demonstrate that a train will be stopped before crossing through a misaligned switch. Although the NTSB recognizes that signal systems currently provide information about switch positions, it asserts that FRA must ensure that any PTC system that uses the signal system to monitor switch positions will provide adequate safeguards to prevent trains from being routed through misaligned switches. Accordingly, the NTSB agreed with FRA's decision to protect switches within sidings with speed limits greater than 20 miles per hour to prevent switch misalignment accidents.

Second, switch monitoring functions of contemporary PTC systems provide an excellent approach to addressing this requirement in dark territory. However, it is important to ensure that switch position is determined with the same degree of integrity that one would expect within a signaling system (e.g., fail safe point detection and proper verification of adjustment). The Working Group puzzled over sidings in dark territory and how to handle the requirement for switch monitoring in connection with those situations. (While these are not "controlled" sidings, as such, they will often be mapped so that train movements into and out of the sidings are appropriately constrained.) At the final Working Group meeting, a proposal was accepted that would treat a siding as part of the main line track structure requiring monitoring of each switch off of the siding if the authorized train speed within the siding exceeds 20 mile per hour. This issue is more fully discussed below.

The costs and benefits of protecting movements over main line switches are included in the general analysis of costs and benefits below. As with the costs and benefits associated with implementation of the other PTC aspects discussed above, the costs and benefits associated with preventing movement of a train through a main line switch in the improper position are attributable to RSIA08.

Other functions. While FRA has included in § 236.1005 the core PTC system requirements, there is the possibility that other functions may be explicitly or implicitly required elsewhere in subpart I. Accordingly, under paragraph (a)(3), each PTC system required by subpart I must also perform any other functions specified in Subpart I. According to 49 U.S.C. § 20157(g), FRA must prescribe regulations specifying in appropriate technical detail the essential functionalities of positive train control systems and the means by which those systems will be qualified.

In addition to the general performance standards required under paragraphs (a)(1)-(3), paragraph (a)(4) provides more detailed performance standards relating to the situations paragraphs (a)(1)-(3) intend to prevent. Paragraph (a)(4) defines specific situations where FRA has determined that specific warning and enforcement measures are necessary to provide for the safety of train operations, their crews, and the public and to accomplish the goals of the PTC system's essential core functions. Under paragraph (a)(4)(I), FRA intends to prevent unintended movements onto PTC main lines and possible collisions at switches by ensuring proper integration and enforcement of the PTC system as it relates to derails and switches protecting access to the main line.

Paragraph (a)(4)(ii) intends to account for operating restrictions associated with a highway-rail grade crossing active warning system that is in a reduced or non-operative state and unable to provide the required warning for the motoring public. In this situation, the PTC system must provide positive protection and enforcement related to the operational restrictions of alternative warning that must be issued to the crew of any train operating over such crossing in accordance with part 234. Paragraph (a)(4)(iii) concerns the movement of a PTC operated train in conjunction with the issuance of an after arrival mandatory directive. While FRA recognizes that the use of after arrival mandatory directives poses a risk that the train crew will misidentify one or more trains and proceed prematurely, PTC provides a means to intervene should that occur. Further such directives may sometimes be considered operationally useful. Accordingly, FRA fully expects that the PTC system will prevent collisions between the receiving trains and the train or trains to be waited upon.

Numerous comments were received related to PTC system functional requirements associated with highway-rail grade crossing active warning systems. At the public hearing, the RLO asserted that the use of technologies providing warning system pre-starts, activation verification, and various health monitoring information related to the warning system to approaching trains needs to be a required component of the PTC system warning and enforcement functionalities where warranted. Some commenters expressed various logistic concerns with the proposed rule language related to operational restrictions issued in response to a warning system malfunction as required by §§ 234.105, 236.106, and 236.107 of this part. However, other commenters asserted that any PTC system functional requirements related to highway-rail grade crossing warning systems fall entirely outside the scope of the statutory mandate contained within RSIA08 and therefore should not be addressed in this rulemaking.

For example, AASHTO submitted comments expressing agreement that inclusion of hazard warning detection in PTC systems for highway-rail grade crossing warning systems is a significant enhancement to mitigate potential risk. AASHTO also underlined its position of enhancing grade crossing safety further by implementation of a program to fully eliminate at-grade highway-rail crossings through consolidation and grade separation wherever possible.

The AAR stated that, while they understand the safety concern, this function is not even remotely related to the “core” PTC functions mandated by Congress. Furthermore, the AAR asserts that the great cost of installing WIUs at grade crossings on PTC routes would be prohibitively expensive and would divert resources that would otherwise be devoted to meeting the mandated PTC deadline.

NJ Transit stated that RSIA08 does not indicate a requirement for highway-rail grade crossing inclusion in the PTC system speed and stop enforcement. Thus, the requirement contained in paragraph (a)(4)(ii) to include warning and enforcement functionality simply adds an additional effort to an already extremely aggressive December 31, 2015 mandate for PTC.

APTA and SCRRA stated that the requirements contained in proposed paragraph (a)(4)(ii) were unclear. APTA and SCRRA recommended that FRA should clarify that the language in paragraph (a)(4)(ii) is intended solely to provide that a dispatcher can place a restriction on a crossing that PTC must enforce in the event that a malfunction is reported. However, paragraph (a)(4)(ii) should not be read to require a PTC system to protect a grade crossing and restrict or prevent a movement authority of a train from being advanced across the crossing in the event of a failure being detected in real time. Nor should paragraph (a)(4)(ii) be interpreted to require a grade crossing warning system to self-monitor and, if in a degraded condition, impose a speed restriction or stop for an approaching train.

NYSMTA states that the addition of highway-rail grade crossings to this subpart falls outside the statutory mandate for PTC systems within the RSIA08. This additional functionality presents an additional burden for LIRR and Metro-North. Both railroads have hundreds of grade crossings in their rail networks. NYSMTA further asserted that the language in paragraph (a)(4)(ii) was ambiguous with respect to whether "warning or enforcement" of reported grade crossing failures would be required, and what constitutes a "warning." Required enforcement will increase the capital cost of PTC, have an adverse impact on operations, risk modifications to ACSES that could trigger verification and validation, and create a further impediment to meeting the other requirements of the proposed FRA regulations. NYSMTA therefore recommended that the final rule be limited at this time to the four requirements of the RSIA08.

FRA believes that, although the RSIA08 does not specifically state that the inclusion of highway-rail grade crossing warning system malfunctions and associated operational requirements must be an integral part of the PTC requirements, it does stipulate that FRA must develop rules and standards for PTC system functionality, which include the four core features identified. In light of the safety-critical nature of the specified operational limitations for providing alternative warning to highway users pursuant to §§ 234.105, 236.106, and 236.107, and the catastrophic consequences that have been experienced all too often when those operational limitations have not been accomplished (which include actual and potential impacts with motor vehicles involving serious injury and loss of life) and the fact that these operational limitations equate to speed and stop targets that PTC systems may surely warn and enforce, FRA intends to carry the language contained within this proposed paragraph into the final rule. Although FRA believes that the proposed rule was clear that its purpose was to enforce dispatcher-issued “stop-and-flag” orders and slow orders associated with credible reports of highway-rail grade crossing warning device malfunctions, reference has been added to “mandatory directives,” a term with a well-established meaning in FRA regulatory parlance (see 49 CFR Part 220).

While FRA recognizes that technologies exist to provide even further interface with warning system activation and health, and encourages railroads to include these technologies to the extent possible, FRA elects to not require those interfaces beyond that which has been already identified within this paragraph.

The NTSB submitted comment recommending that requirements for warning and barrier protection plans for Class 7 track should also apply to class 5 and 6 tracks as part of an approved PTC Safety Plan in order to reduce the risk of high-speed catastrophic derailments at such grade crossings. FRA notes that the requirements contained within § 213.347 of this part require that a warning/barrier plan be approved and adhered to for Class 7 track operations and prohibit grade crossings on Class 8 and 9 track. Those requirements do not, however, address Class 5 and 6 tracks specifically. Therefore, FRA believes that this comment falls outside the scope of the present rulemaking. As noted elsewhere in this preamble, FRA has developed Guidelines for Highway-Rail Grade Crossing Safety on high-speed rail lines that endeavor to raise the bar with a strong emphasis on closures and improved engineering. The Guidelines will be used to review and negotiate grants under ARRA.

FRA recognizes that movable bridges, including draw bridges, present an operational issue for PTC systems. Under subpart C, § 236.312 already governs the interlocking of signal appliances with movable bridge devices and FRA believes that this section should equally apply to PTC systems governing movement over such bridges. While subparts A through H apply to PTC systems―as stated in § 236.1001―paragraph (a)(4)(iv) seeks to make this abundantly clear.

Accordingly, in paragraph (a)(4)(iv) and consistent with § 232.312, movable bridges within a PTC route are equipped with an interlocked signal arrangement which is also to be integrated into the PTC system. A train shall be enforced to a stop prior to the bridge in the event that the bridge locking mechanism is not locked, or the locking device is out of position, or the bridge rails of the movable span are out of position vertically or horizontally from the rails of the fixed span. Effective locking of the bridge is necessary to assure that the bridge is properly seated thereby capable to support both the weight of the bridge and that of a passing train(s) and preventing possible derailment that could result in the train going into the water or other potential unsafe condition. Proper track rail alignment is also necessary to preclude derailments, which again could result in damage to the bridge or the train going into the water. No comments were received on this issue, and the provision is carried forward in the final rule.

Paragraph (a)(4)(v) requires that hazard detectors integrated into the PTC system―as required by paragraph (c) of this section or the FRA approved PTCSP―must provide an appropriate warning and associated applicable enforcement through the PTC system. There are many types of hazard detection systems and devices. Each type has varying operational requirements, limitations, and warnings based on the types and levels of hazard indications and severities. FRA expects this enforcement to include a positive stop where necessary to protect the train (e.g., areas with high water, flood, rock slide, or track structure flaws) or to provide an appropriate warning with possible movement restriction be acknowledged (i.e., hot journal or flat wheel detection). The details of these warnings and associated required enforcements are to be specifically addressed within a PTCDP and PTCSP subject to FRA approval, and the PTC system functions are to be maintained in accordance with the system specifications. FRA does not expect that all hazard detectors be integrated into the PTC systems, but where they are, they must interact properly with the PTC system to protect the train from the hazard that the detector is monitoring. With the exception of the RLO's strong emphasis on safety in PTC deployment, no comments were received on this issue; and the provision is carried forward in the final rule.

Paragraph (a)(5) addresses the issue of broken rails, which is the leading cause of train derailments. For this reason, FRA will strictly limit the speed of passenger and freight operations in those areas where broken rail detection is not provided. Under § 236.0(c), as amended in this rule to sunset of the manual block allowance 24 months after the effective date of a final rule, freight trains operating at or above 50 miles per hour, and passenger trains operating at or above 60 miles per hour are required to have a block signal system. Since current technology for block signal systems relies on track circuits—which also provide for broken rail detection—FRA proposed, and will require in the final rule, limiting speeds where broken rail detection is not available to the maximums allowed under § 236.0 when a block signal system is not installed. No comments were received on this issue; and the provision is carried forward in the final rule.

The costs and benefits of performing other functions are included in the general analysis of costs and benefits below. Even though these other functions were not specifically delineated in RSIA08, FRA believes that they were intended by Congress, and therefore the costs and benefits are attributable to RSIA08.

Deployment requirements. Paragraph (a) of 49 U.S.C. § 20157, as enacted by the RSIA08, reads as follows:

> ‘‘(a) IN GENERAL.—
> ‘‘(1) PLAN REQUIRED.—Not later than 18 months after the date of enactment of the Rail Safety Improvement Act of 2008, each Class I railroad carrier and each entity providing regularly scheduled intercity or commuter rail passenger transportation shall develop and submit to the Secretary of Transportation a plan for implementing a positive train control system by December 31, 2015, governing operations on—
> ‘‘(A) its main line over which intercity rail passenger transportation or commuter rail passenger transportation, as defined in section 24102, is regularly provided;
> ‘‘(B) its main line over which poison- or toxic-by-inhalation hazardous materials, as defined in parts 171.8, 173.115, and 173.132 of title 49, Code of Federal Regulations, are transported; and

‘‘(C) such other tracks as the Secretary may prescribe
by regulation or order.
‘‘(2) IMPLEMENTATION.—The plan shall describe how it will
provide for interoperability of the system with movements of
trains of other railroad carriers over its lines and shall, to
the extent practical, implement the system in a manner that
addresses areas of greater risk before areas of lesser risk.
The railroad carrier shall implement a positive train control
system in accordance with the plan.

It is plain on the face of the statute that certain actions are required and some are discretionary and that these actions must come together progressively over a period beginning on April 16, 2010 (18 months after enactment) and ending on December 31, 2015. FRA has included revisions in this final rule designed to fully express this intent.

In paragraph (b) of § 236.1005 in the NPRM, FRA proposed to fix the network that would receive PTC as of 2008 traffic levels, subject to any requested amendments to the PTCIP which justified removal of the line, and subject to the addition of lines that might qualify under the statutory mandate based on later data. There were several fundamental reasons for doing so in addition to FRA's understanding of the rail lines Congress intended to cover. First, in order to reach completion by December 31, 2015, as required by law, railroads and FRA need to identify the relevant route structure very early in the short implementation period and the railroads need to stage the financing and logistics to reach completion. Otherwise, the statutory deadline will not be met. Second, 2009 traffic levels will be notably atypical as a result of the recession, which has caused overall traffic levels to fall by as much as 20%. Third, the burden of installing PTC, which the statute applies obligatorily to very large railroads but not to others, may create an incentive to further "spin off" certain lines to avoid installing PTC on lines Congress intended to cover. Finally, FRA was concerned about responsive and anticipatory actions being taken by some railroads in the face of emerging regulatory influences. Accordingly, FRA sought in the NPRM to take a snapshot of the Class I system at the time the Congress directed the implementation of PTC and then to evaluate what adjustments might be in order.

The Class I railroads responded with comments that, while raising issues that deserve a response, can only be described as disappointing when compared to the very positive discussion within the PTC Working Group prior to issuance of the NPRM. First, we have the claim that FRA lacks authority to require a PTCIP filing based on the 2008 traffic data. Rather, it was suggested, FRA is without discretion to require inclusion of lines that do not qualify as of 2015. The claim is at least thrice wrong. We have already quoted the statute, which makes clear the inclusion of FRA-identified lines in the 2015 mandate. The statutory "shall" applies to these lines. Next, FRA and its predecessor agency have long enjoyed the power to require installation of train control under the "Signal Inspection Act" (codified at 49 U.S.C. 20501-20505). Further, FRA has been mandated since 1970 to issue rules and standards covering "all areas of railroad safety" (49 U.S.C. 20103). In conferring new responsibilities, the Congress in no sense repealed what preceded them.

Arguing in the alternative, the Class I railroads said that FRA had failed to rely on its discretionary authority to accomplish its purpose. In fact the subject statutory provisions were called out in the authority section of the NPRM text, with the exception of the Signal Inspection Act, as codified (an oversight remedied here).[4] FRA also explicitly stated its intention in the preamble to the NPRM to use its statutory discretion to preserve Congressional intent and tied that intention to the use of 2008 traffic levels. The railroads' ancillary claim is that, in effect, FRA would be "arbitrary and capricious" should the agency require PTC on lines not carrying PIH as of the end of 2015 absent a further congressional mandate or a showing that PTC on the subject lines would be "cost beneficial."

FRA is very conscious of the fact that PTC is expensive, and the agency's Regulatory Impact Analysis for the proposed rule does not seek to conceal it. The unit costs will be particularly high during the period before December 31, 2015, and trying to do too much too fast could result in significant disruption of rail transportation. Accordingly, during the initial implementation period, FRA will not exercise its authority to require a build out of the PTC network beyond something on the order of what the Congress contemplated. However, FRA will not sit "asleep at the switch" and watch the potential PTC network constrict as a result of decisions made in large part to avoid the statutory mandate or based on considerations not relevant to the mandate. FRA will exercise its discretion to ensure that the network design reflects safety needs and places a value on PTC that reflects an understanding of the value applied by the Congress.

FRA understands the arguments surrounding PTC, costs and benefits, having filed three congressionally-required reports since 1994 with information on the subject, having worked through the RSAC for several years evaluating this issue, having funded PTC technology development and overseen PTC pilot projects from the State of Washington to the State of South Carolina, and having provided testimony to the Congress on many occasions. However, FRA believes that the issue is now presented in a different light than before. The Congress was aware that the monetized safety benefits of PTC were not large in comparison with the loss of life and injuries associated with PTC-preventable accidents. With the passage of RSIA08, Congress has in effect set its own value on PTC and directed implementation of PTC without regard to the rules by which costs and benefits are normally evaluated in rulemaking.

One could conclude that the Congress set the value only with respect to passenger trains and PIH releases, but that would assume that the interest expressed by the Congress over much more than a decade and a half was so limited. In fact, longtime congressional interest stemmed in large part from the loss of life among railroad crew members in collisions, as well the potential for release of other hazardous materials. Most of the NTSB investigations and investigations pertaining to this "most wanted" transportation safety improvement in fact derived from such events.

In this light, the focus of the statute on PIH and scheduled passenger trains was clearly intended to provide specific guidance to the agency – a minimum standard for action – and reflected the prominence of passenger trains (Placentia, CA, April 23, 2002; Chatsworth, CA); and PIH releases (Macdona, TX, June 28, 2004; Graniteville, SC) in the most serious of the recent PTC-preventable

[4] Here we recognize the interest of railroads that will be making very costly investments to meet the requirements of the statute and this rule. The "Signal Inspection Act," as codified, makes it explicit that the presence of a signal or train control system on one line may not be considered in a civil action with respect to an accident on another line. This law is also explicit that, once installed, such a system may not be removed without approval. 49 U.S.C. §§ 20501-20505. It should have been cited in the NPRM.

accidents. FRA does not take this to mean that the Congress meant us to be indifferent to the crew fatality at Shepherd, Texas, on September 15, 2005, which resulted from a misaligned main track switch in a collision very similar to the one at Graniteville. Nor do we believe that FRA was expected to be indifferent to the collision between two freight trains at Anding, Mississippi, on July 10, 2005, which killed four crew members, or the collision with release of liquefied propylene gas and ensuing explosion at Texarkana, Arkansas, on October 15, 2005, which killed a resident of a community abutting the railroad.[5] *See*, e.g., Testimony of Robert L. Sumwalt, Vice Chairman, NTSB, before the U.S. Senate Committee on Commerce, Science and Transportation, Subcommittee on Surface Transportation and Merchant Marine, May 22, 2007. Thus, FRA was provided latitude to add lines to those prescribed by Congress for completion of PTC by the end of 2015, a power expressly different from its pre-existing authority to order the installation of signal and train control systems. Although, as noted above, FRA would expect to exercise any such authority with significant reserve, given the high costs involved, it would be an abdication of the agency's responsibility not to determine that the basic core of the Class I system is addressed, *as would be the case based on 2008 traffic patterns*.

The tone of the Class I freight railroad comments only has the effect of underscoring the concern that FRA had in the first instance that railroads might take the wrong lesson from the statutory mandate. The lesson FRA perceives is that the core of the national rail system, which carries passenger and PIH traffic, needs to be equipped with PTC and that Congress used 5 million gross tons of freight traffic, the presence of PIH traffic, and the presence of passenger service as readily perceptible markers identifying the core lines on which Congress wants PTC to be installed. In making its judgments, Congress was necessarily looking at the national rail system as it existed in 2008 when the statute was passed. A corollary of that lesson is that the later disappearance or diminution of one of those markers from a line does not necessarily mean that Congress would no longer see that line as part of the core national rail system meriting PTC. An alternative response would be to adopt policies and tactics that penalize rail passenger service and attempt to drive PIH traffic off the network, consolidating the traffic that remains on the smallest possible route structure for PTC.

The freight railroads do not pretend that FRA is wrong in perceiving that they wish to remove PIH traffic from the network. That is wise, since the public record is replete with pleas from the Class I railroads to remove their common carrier obligation to transport PIH traffic. Rather, they contend in effect that FRA should not trouble itself with this issue, since the Congress and the Surface Transportation Board (STB) will ensure that PIH shippers get a fair shake, and the PHMSA Rail Route Analysis Rule will determine whether the traffic goes on the safest and most secure routes.

There are significant problems with this contention. First, while the Congress shows no interest in relieving the carriers of duty to transport PIH commodities, and the STB has likewise brushed back a recent attempt by a Class I railroad to avoid this duty, it is by no means yet determined how

[5] Unique among these events, the Texarkana collision may not have been prevented by PTC technology now being perfected. However, the consequences which ensued, including the fatality, destruction of two residences and a highway bridge, and a significant evacuation are illustrative of the consequences can that can result from release of flammable compressed gases in train accidents. There are approximately 100,000 carloads of PIH commodities shipped each year. There are approximately 228,000 carloads of flammable compressed gases (other than those classified as PIH) shipped each year.

the cost burden associated with PTC will be borne. A railroad seeking to make the most favorable case for burdening a PIH shipper with the cost of PTC installation would first clear a line of overhead traffic through rerouting and then seek to surcharge the remaining shipper(s) for the incremental cost of installing the system. Under those circumstances, would the STB decide that the railroad should transfer all of those costs to other shippers, or would the STB uphold the surcharge in whole or in part, thereby potentially making the cost of transportation unsupportable? Time will tell, but those answers are unlikely to be available when the railroads are required to file their PTCIPs on April 16, 2010.

The carriers would have us rely on the PHMSA Rail Route Analysis Rule in determining whether the PIH criterion requires installation of PTC on a particular line. The Class I railroads' comments state that "FRA is not even the DOT agency with substantive responsibility for how railroads route TIH." This is an odd point, considering that: (1) the statutory authority for both this rulemaking and the Rail Route Analysis Rulemaking are vested in the Secretary of Transportation, and FRA and PHMSA have a long and well established history of working together for the safe transportation of hazardous materials; (2) as reflected in the rulemaking documents, FRA initiated the Rail Routing action in concert with PHMSA and participated in developing the proposed rule well before the Congress mandated that the rulemaking be concluded; (3) the final rule affirms that PHMSA issued the revision in coordination with FRA and TSA; and (4) by delegation from the Secretary, FRA is the agency responsible for administering and enforcing the Rail Route Analysis Rule and has worked with TSA to provide funding and oversight for development of the risk model intended for use under the rule.

As it happens, FRA has good reason to be concerned with rail routing of PIH commodities (as well as explosives and high level radioactive waste, which are also covered by the PHMSA rule), both on the merits of the routing decisions (as the agency responsible for administering the rule) and in relation to the incidental impacts of re-routing decisions on the network of lines that will be equipped with PTC. Because the Rail Route Analysis Rule addresses both security and safety risks, operations under that rule necessarily lack the transparency typically afforded to safety risks. What FRA can note on the record is as follows:

1. Significant re-routing has already occurred since 2008 as a result of the TSA Rail Transportation Security Rule (73 FR 72130; November 26, 2008). In its comments, CSXT states that the TSA rule "required railroads to modify their routing operations to ensure that only attended interchanges are used for transporting TIH." The resulting changes are said to be "dramatic." (CSXT comments at 12.) The problem with this is that the TSA regulation requires secure chain of custody, not re-routing; and so any re-routing resulting from the TSA regulation presumably resulted from the desire to hold down costs by focusing the handoffs of these commodities where personnel are already employed to oversee the transfers, not from the direct command of the rule itself. This is perfectly sensible, of course, to the extent that the re-routing did not create greater safety or security concerns. But since railroads have contended for years that their current routings were already optimized for safety, investigation is warranted.

2. The Rail Route Analysis Rule is only now being put into effect. Most railroads will not complete their initial analysis until the first quarter of 2009, using 12 months of 2008 data

(per their request in the subject rulemaking). While the rule requires railroads to consider the use of interchange agreements when considering alternative routes, FRA has not had the opportunity to verify that this has actually occurred with the two railroads opting to comply with the September 2009 date.

3. The risk model intended to provide the foundation for the Rail Routing process is still subject to considerable refinement. No methodology is currently specified for evaluating the potential impact of a PTC system (which would vary in risk reduction depending upon the underlying or previous method of operation). Under these circumstances, there is a distinct possibility the railroads may not give sufficient weight to train control (existing or planned).[6] Railroads are not required to submit their route analysis and route selections to FRA for approval. While FRA intends to aggressively oversee railroads' route analysis and route selections, including their consideration of PTC, and require rerouting when justified, this process will be resource-intensive and time-consuming to complete. So FRA sees no reason necessarily to defer in this context to decision making made under the Rail Route Analysis Rule, even as to the role of PTC in safeguarding the transportation of traffic within its ambit (PIH, certain explosives, and spent nuclear fuel). Instead, those decisions are simply useful information under this rule. In April of 2010 when railroads must complete their PTCIPs, a railroad may know its own routing decisions under the Rail Route Analysis Rule, but not FRA's evaluation of those decisions. Furthermore, the Rail Route Analysis Rule analysis does not consider the safety risk posed by the rail movement of hazardous materials it does not cover—but, as noted above, this is a legitimate concern when deciding where to put PTC.

4. The Rail Route Analysis Rule considers both safety and security, and PHMSA and FRA have worked with TSA to ensure that the inherently speculative risk of a security incident does not overwhelm known safety risks in the decision making. At the same time, the structure is very responsive to known threats and special circumstances. However, FRA is aware of at least one railroad that has balanced its evaluation of safety and security risks under the rule affording equal weight to each across the board. FRA will be working with that railroad to determine the basis for this action and may later require the railroad to revise its analysis and possibly reroute traffic. *See* Railroad Safety Enforcement Procedures; Enforcement, Appeal and Hearing Procedures for Rail Routing Decisions (73 FR 72194; November 26, 2008).

5. Since any given railroad may have thousands of origin-destination pairs for its PIH traffic, and since railroads are just at the threshold of cooperation to evaluate interline re-routing options, this new program will settle out over a period of several years during which lessons are learned. As custodian of this program, FRA is best situated to conclude that using the products of initial analysis within a framework that confers significant discretion to utilize judgment should not control where PTC is built—particularly given the strong incentives that carriers perceive to reduce the wayside mileage equipped with PTC and

[6] At least one Class I railroad consolidated some of its PIH traffic on signalized lines prior to adoption of the Rail Route Analysis Rule. This reflects a recognition that method of operations matters, but that is not the same thing as having completed a fully mature routing analysis against the 27 factors—something that will occur only over time in the face of great complexity.

the fact that installation of PTC might overwhelm other considerations with respect to PIH routing.

In the proposed rule, FRA said that changes from the 2008 base could be granted if "consistent with safety." Even though this is a familiar phrase drawn from FRA's basic safety statute, concern was expressed regarding how this term might be applied. The final rule further defines that standard by adding a rule for FRA decision making, i.e., if the remaining safety risk on the line exceeds the average safety risk per route mile on lines carrying PIH traffic, as determined in accordance with Appendix B to 49 C.F.R. Part 236, FRA denies the request. The provision leaves open the possibility of granting the request if the railroad making application offers a compensating further build out on another line where the resources would be better spent because they would enhance safety to a greater degree. FRA has available to it adequate data to construct a simple risk model for use in this context and expects to do so in consultation with the industry stakeholders through the RSAC. This provision treats similarly risky rail lines similarly in carrying out the perceived congressional intent for PTC to be installed on the portion of the rail system Congress described, and it is an appropriate exercise of FRA's statutory discretion because it is rationally related to the reduction in risk Congress sought to achieve across the national rail system.

The structure of paragraph (b) of § 236.1005 is as follows:

Paragraph (b)(1) brings together the policy of the statute requiring a phased, risk-based roll out of PTC with the types of lines required to be equipped. FRA has included the additional language "progressively equip" to remind the industry that the law does not expect a risk-based implementation in which no safety benefits are achieved until December 31, 2015. To the contrary, the law and FRA evidence a strong expectation that PTC safety benefits will be increasingly achieved as lines are equipped and as locomotives are equipped. *See* § 236.1006). FRA was distressed to hear claims in the Class I railroad testimony and filings to the effect that, not only are the railroads under legal obligations to deploy incrementally and take advantage of safety technology required by the law, but FRA is without authority to require operation of PTC until December 31, 2015. We consider both claims to be without merit on the face of the law, including FRA's pre-existing authority over signal and train control systems.

Paragraph (b)(2) describes the operation of the 2008 baseline as a point of departure for PTC implementation. The section is clear to the effect that if any line segment mandated for PTC exclusively on the basis of PIH traffic falls below 5 mgt for two consecutive years, the line would be eligible for removal. The paragraph also identifies the presence of PIH traffic in 2008 (or prior to filing the PTCIP) as initially placing the line in the PTCIP, but refers to paragraph (b)(4) as a means of removing it.

Paragraph (b)(3) refers to changed conditions after the filing of the PTCIP that might require a line to be added. This could occur, *inter alia*, because overall freight volume increases, a shipper requests PIH service on the line, or PIH traffic is (actually or prospectively) re-routed over the line to satisfy the Rail Route Analysis Rule. The provision requires "prompt" filing when conditions change. It makes clear that the railroad will have at least 24 months after approval of its RFA to install the PTC system on the line.

In the NPRM, FRA proposed that, in order to have a line segment no longer carrying the PIH traffic be excepted from the requirement that it be initially equipped, the railroad would need to provide estimated traffic projections for the next 5 years (e.g., as a result of planned rerouting, coordinations, location of new business on the line). In addition, where the request involves prior or planned rerouting of PIH traffic, the railroad would be required to provide a supporting analysis that takes into consideration the rail security provisions of the PHMSA rail routing rule, including any railroad-specific and interline routing impacts. FRA proposed that it could approve an exception if FRA finds that it would be consistent with safety and in the public interest.

The AAR acknowledged in its comments that "FRA does offer railroads the ability to apply to FRA for approval to not install PTC on a route which, in 2015, is no longer used for PIH traffic or which no longer meets the definition of a main line." However, asserted AAR, "FRA approval is predicated on the nebulous criteria of "consistent with safety and in the public interest."

In the final rule, paragraph (b)(4) provides the methods by which a railroad may seek the exclusion or removal of track segments from their PTCIP. Paragraph (b)(4)(i) deals with the evaluation of line segments that no longer carry 5 mgt or PIH traffic that the railroad seeks to remove from the PTCIP, either at the time of initial filing or through an RFA thereafter. A request to remove a line would need to be accompanied by future traffic projections. FRA understands that, in some cases, railroads will not be able to say with certainty whether total tonnage or PIH traffic will return to a line; and certainty is not required. However, in other cases a railroad may in fact be able to make reasonable projections (because of control over a parallel main line that is approaching capacity, planned coordination with another railroad, etc.

In the case of cessation of passenger service or a decline of tonnage on a PIH line, FRA anticipates that approval of such requests will normally be routine. However, in light of AAR's comments, the final rule provides that, where PIH traffic has been removed (or is projected to be removed), three conditions must be met in order for FRA to approve such requests. First, it is not expected that there will be any local PIH traffic on the line segment. Second, to the extent overhead traffic has been (or will be) removed from the line, the request must be supported by routing analysis justifying the alternative routing of any traffic formerly traversing the line or which might traverse the line as an alternative routing. This is not the same routing analysis required under part 49 CFR Part 172, but it may be presented in the same format. The difference is that, under the Rail Route Analysis Rule, the current best route for the movement of security sensitive materials (which included PIH materials) must be determined, taking into consideration both safety and security and assuming the existing method of operation, any changes that a carrier may reasonably be anticipated to occur in the upcoming year, and any mitigation measures that the carrier intends to implement.. The question that needs to be addressed for PTC planning is the future best route, taking into consideration the fact that any route used for PIH will need to be equipped within the schedule contained in the approved PTCIP (but not later than December 31, 2015 for the least risky lines that need to be equipped). This is a strategic question which applies to the carrier's entire network. Accordingly, this analysis would need to show that, even by equipping the subject line with PTC, it would not have an advantage over the route proposed to be selected.

As noted in section VI of this preamble, FRA continues to seek comments on how elements of a route analysis should be weighed by FRA when determining whether to rerouting under this paragraph is sufficiently justified.

FRA includes one additional requirement that invokes its discretionary authority under the law. Even if a line has not or will not carry PIH traffic after the 2008 base year or later time period prior to filing of the PTCIP, the final rule requires an additional test which fleshes out the "consistent with safety" notion contained in the proposed rule with the desired objective of providing greater predictability, transparency and consistency in decision making. This test requires that, in order for a line segment to be excluded, the remaining risk on the line not exceed the average risk extant on lines required to be equipped with PTC because they meet the threshold for tonnage of 5 mgt and carry PIH traffic. The effect of this test should be to allow a majority of lines that formerly carried PIH which has been removed for legitimate reasons to be removed from the PTCIP. With no intercity/commuter passenger traffic and no PIH, these will mostly be lines with moderate traffic involving commodities such as coal or grain and minimal quantities of other hazardous materials. However, with respect to lines with higher risk, FRA does not believe that consolidation of PIH traffic due to security reasons should unduly influence deployment of PTC. Train crews, roadway workers, and communities along the routes have a strong interest in seeing PTC provided for their benefit. Examples of lines that could be captured by this requirement are very high density lines to coal fields or between major terminals where collision risk is significant and other very dangerous or environmentally sensitive hazardous materials are transported in significant quantities (e.g., flammable compressed gas, halogenated organic compounds). Non-signaled lines with traffic nearing capacity and many manually operated switches, together with significant hazardous materials, would also be candidates for retention.

As previously noted in the Introduction and section VI to the preamble to the final rule, FRA seeks further comments on paragraph (b)(4)(i). This provision describes the specific considerations FRA will take into account in determining whether a deviation from the baseline is "consistent with safety." FRA believes that the final rule could still benefit from input concerning this application of the "consistent with safety" standard (which FRA has applied for decades in considering waivers under 49 U.S.C. 20103(d)), and whether FRA should interpret that standard differently or in greater detail here. Accordingly, FRA continues to seek comments on this issue with the desired objective of providing greater predictability, transparency, and consistency in decision making. More specifically, FRA seeks comments that would help clarify what issues, facts, standards, and methodologies it should consider when determining whether to approve a request for amendment made pursuant to paragraph (b)(4)(i). FRA also seeks comments on how it should compare the levels of risk between lines with PIH and lines without PIH for the purposes of paragraph (b)(4)(i).

Paragraph (b)(4)(ii) contains a new provision which provides a process for a railroad to request removal of a track segment from a PTCIP either at the time of initial filing or through an RFA thereafter. The provision is being added in an effort to response to comments submitted on the NPRM requesting a *de minimus* exception for low density track segments with minimal PIH traffic. The AAR noted that under the proposed regulations, even one car containing a PIH on a main line would require installation of PTC. AAR believes that this position is untenable in light of the cost-benefit concerns (e.g., the 15 to 1 cost to benefit ratio under FRA's economic analysis), especially on routes with minimal PIH traffic. The AAR takes the position that it would therefore be arbitrary and capricious for FRA to not employ a *de minimis* exception. According to AAR, its preliminary analysis shows that a meaningful *de minimis* exception could save the industry hundreds of millions of dollars without significantly changing the safety benefit calculation.

The AAR and its member railroads assert that FRA has the authority to include a *de minimis* exception in the final rule. In separate comments, CSXT also recommends that FRA recognize a *de minimis* exception for PIH transport. CSXT asserts that, in cases where a limited quantity of PIH materials are transported on a particular route – or where a segment of track happens to carry PIH materials on a single occasion because of mere happenstance – there are no safety benefits that would justify costly PTC implementation. In addition, in the absence of specific language in the RSIA08 that would preclude FRA from recognizing a *de minimis* exception, CSXT asserts that FRA possesses the requisite authority to do so. In support of this assertion, CSXT points to three cases from the D.C. Circuit (*Shays v. FEC,* 414 F.3d 76 (D.C. Cir. 2005); *Environmental Def. Fund, Inc. v. EPA,* 82 F.3d 451 (D.C. Cir. 1996); and *State of Ohio v. EPA*, 997 F.2d 1520 (D.C. Cir. 1993)), in which the D.C. Circuit acknowledged the inherent authority conferred upon agencies, in the absence of an express prohibition, to promulgate a *de minimis* exception as a tool for implementing legislative design and avoiding pointless expenditures of effort.

FRA has reviewed the suggestion of the Class I railroads that FRA possesses an inherent, or at least reasonably inferred, authority to withhold any requirement for deployment of PTC on lines with very low risk. FRA agrees that, as a general matter, it has an inherent authority to create *de minimis* exceptions in its regulations to statutes FRA administers. In fact, FRA has utilized this inherent authority in this final rule in the following areas: providing limited exceptions for yard operations; addressing the movement of equipment with inoperative PTC systems; and providing for limited movements by non-equipped trains operated by Class II and Class III railroads over PTC equipped main line.[7] FRA believes these are all appropriate uses of its discretionary authority. Based on existing case law as well as its review of the comments provided in this proceeding, FRA believes that a *de minimus* exception to the statutory mandate requiring the installation of PTC systems on any and all main lines transporting any quantity of PIH hazardous materials should also be provided to low-density main lines with minimal safety hazards that carry a truly minimal quantity of PIH hazardous materials.

With this said, however, and as explained below, that discretionary authority will not sustain the creation of the broad-brush exception sought by the Class I railroads in this proceeding. United States Circuit Court decisions recognize that Federal agencies may promulgate *de minimus* exemptions to statutes they administer. *See, e.g., Shays v. FEC*, 414 F.3d 76, 113 (D.C. Cir. 2005); *Ass'n of Admin. Law Judges v. FLRA*, 397 F.3d 957, 961-62 (D.C. Cir. 2005) ("[T]he Congress is always presumed to intend that pointless expenditures of effort be avoided" and that

[7] This is not to say that there are independent justifications for each of these decisions. Yard operations involve a mix of switching movements and train movements and have never been within public expectations for PTC because of issues of impracticability and inapplicability, as well as greatly reduced safety concerns. Movement of trains with inoperative PTC equipment has historically been allowed for and governed within Interstate Commerce Commission and FRA regulations, and proceeding otherwise would be a virtual impossibility. FRA does not understand the RSIA to specify whether all trains operating on PTC lines must be PTC equipped, and accordingly FRA believes that it is required to make discretionary decisions in that regard. That said, the *de minimis* concept clearly offers an alternative justification for each of these decisions.

such authority "is inherent in most statutory schemes, by implication."); *Environmental Defense Fund, Inc. v. EPA*, 82 F.3d 451, 466 (D.C. Cir. 1996) ("[C]ategorical exemptions from the requirements of a statute may be permissible as an exercise of agency power, inherent in most statutory schemes, to overlook circumstances that in context may fairly be considered de minimus.") (inner quotations and citation omitted); *Alabama Power Co. v. Costle*, 636 F.2d 323, 360 (D.C. Cir. 1979) (the ability to create a *de minimus* exemption "is not an ability to depart from the statute, but rather a tool to be used in implementing the legislative design."); *New York v. EPA*, 443 F.3d 880, 888 (D.C. Cir. 2006) (noting the maxim *de minimus non curat lex* – "the law cares not for trifles.").

However, "a de minimus exemption cannot stand if it is contrary to the express terms of the statute." *Environmental Defense Fund*, 82 F.3d at 466 (citing *Public Citizen v. Young*, 831 F.2d 1108, 1122 (D.C. Cir. 1987)). In other words, agency authority to promulgate *de minimus* exemptions does not extend to "extraordinarily rigid" statutes. *See Shays*, 414 F.3d at 114 ("By promulgating a rigid regime, Congress signals that the strict letter of its law applies in all circumstances . . .."); *Ass'n of ALJs*, 397 F.3d at 962; *Alabama Power,* 636 F.2d at 360-61 (As long as the Congress has not been "extraordinarily rigid" in drafting the statute, however, "there is likely a basis for an implication of de minimus authority . . .."). Furthermore, such authority does not extend to situations "where the regulatory function does provide benefits, in the sense of furthering regulatory objectives, but the agency concludes that the acknowledged benefits are exceeded by the costs." *Public Citizen v. FTC*, 869 F.2d 1541, 1557 (D.C. Cir. 1989) (quoting Alabama Power, 636 F.2d at 360-61) (emphasis removed); *see also Shays*, 414 F.3d at 114; *Kentucky Waterways Alliance v. Johnson*, 540 F.3d 466, 483 (6th Cir. 2008). "Instead, situations covered by a de minimis exception must be truly de minimis. That is, they must cover only situations where 'the burdens of regulation yield a gain of trivial or no value." *Environmental Defense Fund* at 466.

In this case, where release of the contents of one tank car can have catastrophic consequences, FRA must determine whether the gain yielded by installing PTC on any rail line that carries a minimal amount of PIH materials is "of trivial or no value." During the RSAC Working Group discussions conducted on August 31-September 2, 2009, the major freight railroads suggested that any line segment carrying fewer than 100 PIH cars annually should be considered to present a *de minimis* risk and be subject to an exception. (Their representatives were very clear that the request did not extend to lines carrying intercity or commuter passenger trains.) During the Working Group discussion, AAR was asked to describe additional safety limitations that might apply to these types of line segments (e.g., tonnage, track class, population densities). The AAR elected not to do so, adhering to the simple less than 100 car exception. Subsequently, in an October 7, 2009 docket filing, AAR suggested that safety mitigations could be applied where necessary to bring risk down to de minimis levels.
FRA has considered the proposed exception and has noted that, although the number of cars appears small, in fact only about 100,000 loaded PIH cars are offered for transportation in the United States each year (approximately 200,000 loads and residue cars). Accordingly, FRA would expect that such an exception might have a significant impact on the number of miles of railroad subject to the PTC mandate. None of the filings in this docket, and none of the discussion in the RSAC Working Group, sheds light on the relevant facts despite an express request from FRA to Class I railroads to supply facts bearing on their requested exception. Based on the limited

information available to FRA, FRA believes that such an exception would excuse installation of PTC on roughly 10,000 miles of railroad out of the almost 70,000 route miles FRA has projected would need to be equipped based on the proposed requirements. Based on the limited information available, it appears that some of the lines within the AAR request carry very heavy tonnages (with many train movements raising the risk for a collision) at freight speeds up to 60 or 70 miles per hour (predicting severe outcomes when accidents do occur). Putting trains with PIH bulk cargoes into this mix in the absence of effective train control would not be a de minimis risk as to those cars of PIH actually transported. Further, any public policy decision to excuse PTC installation under these circumstances would have to ignore other risk on those track segments. Creating a de minimis exception for less than 100 PIH cars on a very busy and risk-laden track segment simply on the basis of the number of PIH cars would, accordingly, ignore the separate charge that the Congress gave to the agency in 1970 to adopt regulations "as necessary" for "for every area of railroad safety" (49 U.S.C. § 20103(a)) and the value that the Congress has obviously placed on PTC as a means of reducing risk within the reach of the four PTC core functions under the RSIA08. Further, it would stand on its head the structure of 49 U.S.C. § 20157, as added by the RSIA08, which mandates completion by the end of 2015 of PTC on (1) lines of intercity and commuter passenger trains, (2) lines of Class I railroads carrying 5 million gross tons and PIH, and (3) "such other tracks as the Secretary may prescribe by regulation or order."

FRA believes that the broad-based type of *de minimus* exception sought by the AAR and its member railroads based solely on the number of PIH cars transported annually is not supported either legally or on a safety basis. However, FRA believes a limited exception is necessary and justified for those main lines that transport a truly limited quantity of PIH materials and that pose little safety hazard to the general public by not being equipped with an operational PTC system. . Thus, FRA is including paragraph (b)(4)(ii) in this final rule to permit railroads exclude these types of main track segments from the statutory requirement to install a PTC system. The initial qualifying criterion is that of less than 100 PIH cars per year (loaded or residue), as suggested by the AAR.

In order to foster as much clarity as possible regarding the exceptions provided, FRA has broken the concept into two separate divisions. The first creates a presumption that a requested exception will be provided based on existing circumstances on the line, plus an operating restriction. The second involves more challenging circumstances and involves no presumption, but the railroad may proffer safety mitigations in order to drive down risk to demonstrably negligible levels (subject to FRA review). Both are limited to lines that carry less than 15 million gross tons of traffic annually, a figure three times the threshold in the law. FRA has no confidence that a railroad could assure "negligible risk" in a busier and therefore more complex operation, and allowing for consideration of lines with more traffic could lead to neglect of other risk of concern (e.g., harm to train crews in collisions, casualties to roadway workers, release of other hazardous materials).

Paragraph (b)(4)(ii)(B) specifies additional tests that apply to the first exception:

- The line segment must consist exclusively of Class 1 or 2 track under the Track Safety Standards (maximum authorized speed 25 mph);

- The line segment must have a ruling grade of less than 1 percent; and

- Any train transporting a car containing PIH materials (including a residue car) must be operated under conditions of temporal separation, , as explained in § 236.1019(e) and in Appendix A to part 211 of this title, from other trains using the line segment, as documented by a temporal separation plan submitted with the request and approved by FRA.

Limiting maximum authorized train speed reduces the kinetic energy available in any accident, and the forces impinging on the tank should be sustainable.[8] Placing a limit on ruling grade helps to avoid any situation in which a train "gets away" as a result of a failure to invoke a brake application until momentum is such that no stop is possible (as the surface between the brake shoe and wheel "goes liquid"). (PTC can prevent the initial overspeed and intervene early.) Requiring that a train carrying PIH and other trains be "temporally separated" can help prevent a collision in which a PIH car is struck directly by the locomotive of another train while traversing a turnout (potentially exceeding the force levels the tank can withstand). Given these combinations of circumstances, a de minimis exception should ordinarily be warranted. FRA would withhold approval only upon a showing of special circumstances, such as where there might be a need to protect movements over a moveable bridge. Should FRA identify such a circumstance, the railroad might elect to proceed under the additional exception.

Paragraph (b)(4)(ii)(C) provides an alternative path to a de minimis exception by opening the door for proposed risk mitigations that could drive risk down to negligible levels. The railroad could offer any combination of operating procedures, technology or other means of risk reduction. FRA would evaluate the submittal, and if satisfied that the proffered mitigations would be successful, approve the exception of the line segment. FRA wishes to note that elements of PTC technology may in some cases provide the means for accomplishing this. Developing a track database for a line segment, installing an intermittent data radio capability, and utilizing PTC-equipped locomotives on the line could be used to enforce temporary speed restrictions and enforce track warrants without the major expense on the wayside. Where necessary based on somewhat higher train speeds, key switches could be monitored; or, alternately, only those trains containing PIH cars could be speed restricted (with speed enforced on board). The notion here is to leverage investments already made with modest additional expenditures that capture the bulk of the safety benefits while specially protecting trains with PIH cars.

FRA believes that the savings from these provisions should be substantial. Most of the line segments falling within the criteria set forth for de minimis risk will be non-signaled lines with limited freight traffic. The ability to omit equipping these routes with full data radio infrastructure and with switch position monitoring at all switches should constitute a significant savings. In fact, based on available information FRA believes that as much as 3,500 miles of railroad could be included in one of the exceptions provided. FRA estimates that the gross savings from omitting

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[8] See ***Engineering Studies on Structural Integrity of Railroad Tank Cars Under Accident Conditions*** (DOT/FRA/ORD-9/18; October 2009); see 78 FR 17,818, 17,821 (Apr. 1, 2008) (discussion of proposed limitation on PIH train speeds in non-signaled territory prior to introduction of fully crashworthy tank cars, which was later withdrawn for other reasons).

PTC from these lines might amount to about $175 million and that mitigations might offset roughly $32 million of those savings, for net savings still exceeding $140 million. Of that amount, approximately $15 million could come from the first exception, which deals with very low risk lines left in their current state and operated under temporal separation of trains containing PIH traffic.

This provision was developed in the absence of a robust record. On October 7, 2009, the AAR filed supplementary comments offering to work with FRA on a more flexible process for de minimis exceptions that would consider safety mitigations designed expressly to drive risk down to de minimis levels on candidate line segments. FRA attempted to respond to this late-filed comment in full recognition that the final rule will impose substantial costs and that avoid unnecessary cost is desirable. However none of the parties has had an opportunity to comment on the exception provided in this final rule. Accordingly, FRA seeks comments on the extent of the de minimis exception. Such comments should be supported by sufficient and applicable safety data. .FRA notes that time required for refinement of this provision should fit within the existing PTC system implementation timetable, since any lines where risk is low will be slated for PTC system installation relatively late in the implementation period that ends on December 31, 2015.

Paragraph (b)(5) addresses an additional reason for proposing to use 2008 data as a baseline for PTC installation, rather than *de facto* conditions in 2015: i.e., the prospect that Class I railroads will divest lines in order to avoid the PTC mandate. Based on past practice at the Interstate Commerce Commission and the STB, lines sales can occur under circumstances where the new operator of the line is to a large extent the alter ego of the seller. The seller may retain overhead trackage rights or merely lease the line; or circumstances may be such that the seller is the only available interchange partner and thus continues to enjoy the "long haul" portion of the rate. Typically the buyer will have a lower cost structure, and to the extent the sale is merely a recognition that the line has declined in traffic and will need to be redeveloped as a source of carload traffic, that may be the best way to preserve rail service. However, to the extent that the seller sheds costs while retaining significant practical control and depriving the buyer of adequate revenues, safety issues can arise. FRA has historically been reluctant to allow discontinuance of signal systems in some of these cases, particularly where it remained within the seller's ability to rebuild overhead traffic on the line downstream, where the seller retained the right to repossess the property at a later time, or where the line carried passenger traffic.

This background may help explain why FRA made reference to the issue of whether omitting PTC on a line that carried PIH traffic in 2008 might be "in the public interest" in the proposed rule. In references during the subsequent RSAC working group deliberations, some question was raised about what that could mean. In light of that confusion, FRA has omitted the phrase from the final rule but has added language addressing the issue of line sales that expresses more directly how FRA would handle line sales and modifications to a PTCIP. FRA's purpose is to ensure that decisions regarding where PTC is deployed are made in light of all the relevant circumstances. To the extent that this approach represents an exercise of discretionary authority (and should any such exercise in fact occur), FRA would expect to make the decision based upon safety criteria after the STB had determined the public interest with respect to rail service. Again, FRA would expect to recognize the value that the Congress placed on PTC as a means of risk reduction while not rewarding transactions designed to avoid installation of PTC on the line in question.

Paragraph (b)(6) states that no new intercity or commuter passenger service shall commence after December 31, 2015, until a PTC system certified under this subpart has been installed and made operative. FRA believes this is a clearly necessary requirement to satisfy the statute. FRA has removed the reference to "continuing" of previous passenger service in response to the comments. FRA agrees that the remedy associated with any delays in completing PTC should be determined based upon circumstances at the time and without disfavoring passenger service in relation to freight service.

General Objections to a 2008 Baseline

FRA is aware that the approach embodied in the final rule may not play out as an elegantly optimized risk reduction strategy. If FRA were writing on a blank slate, the agency would describe factors that drive risk and thresholds for those factors, taking into consideration more than PIH and intercity/commuter passenger traffic. Some lines that the Congress has required to be equipped by the end of 2015 because of PIH traffic would be left for deployment well downstream. At least in theory, others with heavy train counts or without signal systems (and with robust traffic) would be added to the list for deployment of PTC by the end of 2015. But FRA is not writing on a clean slate. Rather, FRA is endeavoring to implement the statute with fidelity both to its terms and its intent, utilizing the discretion underscored by the law to get the job done.

Part of the complexity of this task is the schedule. FRA has labored to publish this final rule as soon as humanly possible so that the industry could be ready to file PTC Implementation Plans by the statutory date of April 16, 2010. FRA will then be required, again by the statute, to approve or disapprove each plan within a period of 90 days. Accordingly, establishing some degree of order in framing the Implementation Plan requirements is clearly necessary. Taking the 2008 traffic base as a known starting point, and evaluating any deviations from that base, will permit FRA to identify any potentially inappropriate traffic consolidations and focus on those areas as matters for review. FRA could, of course, take a different approach and order a categorically broader implementation. However, that has been understandably opposed by the railroads; and crafting any such approach would likely not have been feasible during the time available for this rulemaking. Accordingly, what we have done in § 236.1011(b) is to require the PTCIP to include a statement of criteria that the Class I railroad will apply in planning future deployment of PTC and a requirement that the railroad's Risk Reduction Program Plan (required by the RSIA08 to be filed in 2013) contain a specification of additional lines that will be equipped in full (meeting all of the requirements of subpart I) or as a partial implementation (subset of functionalities). Approaching the end of the initial deployment period, therefore, FRA should be in a position to consider whether requiring additional PTC deployments will be appropriate to address remaining risk or whether elective actions by the railroads will meet that need. Over time, then, any rough edges that remain should be smoothed over.

Another objection to the 2008 baseline is that more may need to be accomplished in the period between enactment and December 31, 2015. FRA responds as follows: First, no more will need to be done than the Congress likely expected. If FRA did not foresee the "dramatic" consolidation of PIH traffic resulting from the TSA rule, it is pretty unlikely that the Congress did. Second, the Class I freight industry has had it within its control to get this done, and one of the major objectives of the FRA in conducting this rulemaking has been to ensure success by keeping the technology bar at a reasonable height and deferring as much as possible to work already accomplished. During the most September 10, 2009 RSAC PTC meeting, the Interoperable Train Control project leaders advised the PTC Working Group that interoperability standards for the general freight system—standards that many commuter railroads and Amtrak will need to employ in order to work in concert with the major freight carrier – will not be available until the end of 2010. But the industry developed Advanced Train Control Standards in the 1980s, standards that FRA pronounced mature in its 1994 Report to Congress on Railroad Communications and Train Control, after which the industry abandoned the project. PTC interoperability standards were identified as a need in the consensus report of the original PTC Working Group to the Administrator in 1999, and creation of such standards was a major deliverable of the North American PTC Program (funded jointly by the FRA, industry, and the State of Illinois). That delivery was never made. In the interim, the major signal suppliers, working through the American Railway Engineering and Maintenance Association managed to produce interoperability standards (again with FRA support), but these are not standards that the freight railroads have elected to employ. Accordingly, FRA concludes that the principal obstacle to completion of PTC is the perfection of technology, including interoperability standards, by an industry that has had two decades to work. Any further delays in that quadrant should not deprive the Nation of a reasonably scaled PTC deployment.

FRA received generally favorable comments on the base year issue from Friends of the Earth[9] and the Rail Labor Organizations. The Chlorine Institute also urged the broadest application of PTC to the national rail network, and the American Chemistry Council submitted generally favorable comments without lingering on this specific issue. The Fertilizer Institute commented that limiting lines to the 2008 PIH network could restrict shipping options in the future and also advocated a broader mandate.

FRA has further considered the need to optimize the risk reduction strategy captured in this final rule with respect to lines that may no longer carry PIH traffic as of some point (whether at filing of the PTCIP or thereafter). FRA has included a requirement that the subject line from which PIH has been removed would be required to be equipped with PTC only if the line's remaining traffic involves a level of risk that is above the average for lines that carry PIH traffic. As noted above, FRA would expect most lines from which PIH traffic might be legitimately removed, exclusive of those that carry intercity/commuter passenger traffic (which will need to be equipped in any event), to fall below the average and be removed from the PTCIP. These will be primarily what are referred to as branch lines or secondary main lines, carrying moderate traffic volumes. However, if a line such as a very busy coal line with intermixed general freight (including, e.g., flammable compressed gas or halogenated organic compounds) were in question, FRA would expect that line to be equipped. Further optimization of this approach is offered in the form of compensating risk reduction. That is, a railroad could offer up a line that was not included in 2008 traffic base for PTC implementation if it carries traffic that involves very substantial risk. Although this option is offered, FRA does not expect any such situation to arise. Based on FRA's review of known traffic flows and densities, FRA expects that most lines omitted from those

[9] Friends of the Earth also made detailed comments regarding administration of the Rail Route Analysis Rule that are beyond the scope of this proceeding.

reported in the PTCIP based on 2008 data will fall into a very low range of risk in relation to lines carrying PIH traffic. Further, FRA believes it is very unlikely that any legitimate consolidation of PIH traffic after 2008 would have utilized a line that was not previously carrying at least some PIH traffic. In short, although the agency may not have taken the same approach, there is wisdom behind the Congressional formulation based on conditions when the Congress acted.

In summary, FRA has fashioned an approach to review of candidate line segments for PTC Implementation that seeks to uphold the letter and the intent of the RSIA08, that utilizes FRA discretionary authority sparingly but in a risk-informed manner, that it is administerable within the time allowed by law to review PTCIPs, that offers the best chance of creating some stability in deployment strategy by permitting the agency to focus on areas of greatest sensitivity early in the process (including, as necessary, a threshold evaluation of whether Rail Route Analysis Rule decisions require further evaluation), and that will ensure to the extent possible that safety alone is the governing criterion in determining where PTC will be required to be deployed.

Paragraph (c) provides amplifying information regarding the installation and integration of hazard detectors into PTC systems. Paragraph (c)(1) reiterates FRA's position that any hazard detectors that are currently integrated into an existing signal and train control system must be integrated into mandatory PTC systems and that the PTC system will enforce as appropriate on receipt of a warning from the detector. Paragraph (c)(2) requires that each PTCSP submitted by a railroad must identify any additional hazard detectors that will be used to provide warnings to the crew which a railroad may elect to install. The PTCSP must also clearly define the actions required by the crew upon receipt of the alarm or other warning or alert. FRA does not expect a railroad to install hazard detectors at every location where a hazard might possibly exist.

Paragraph (c)(3) requires, in the case of high speed service (as described in § 236.1007 as any service operating at speeds greater than 90 mph), that the hazard analysis address any hazards on the route and provide a reason why additional hazard detectors are not required to provide warning and enforcement for hazards not already protected by an existing hazard detector. The hazard analysis must clearly identify the risk associated with the hazard, and the mitigations taken if a hazard detector is not installed and interfacing with a PTC system. For instance, in the past, large motor vehicles with parallel or overhead structures have been left fouling active passenger rail lines. Depending upon the circumstances, such events can cause catastrophic train accidents. Although not every such event can be prevented, detection of such obstacles may make it more likely that the accident could be prevented.

In its comments, Amtrak assumes that on those lines where FRA has previously approved such speeds (e.g., portions of Amtrak's Northeast Corridor (NEC) and Michigan line), a new hazard analysis, which would serve only to allow that which is already allowed, will not be required. If so, it asserts that the rule should make that explicit. FRA has done so in the final rule. No further changes were indicated by the comments.

Under paragraph (d), the final rule requires that each controlling locomotive operating with a PTC system be equipped with an operative event recorder that captures safety-critical data routed to the engineer's display that the engineer must obey, including all mandatory directives that have been electronically delivered to the train, authorized speeds to include civil speed restrictions, temporary speed restrictions, and signal-based speed restrictions, warnings presented to the crew, including countdowns to braking enforcement and warnings indicating that braking enforcement is in effect, all crew prompts including work zone functions and track selection functions (if required), and the current system state (“ACTIVE”, “FAILED”, “CUTIN”, “CUTOUT”, etc.)

FRA intends that this information be available in the event of an accident with a PTC-equipped system to determine root causes and the necessary actions that must be taken to prevent reoccurrence. Although FRA expects implemented PTC systems will prevent PTC-preventable accidents, in the event of system failure FRA believes it is necessary to capture available data relating to the event. Further, FRA sees value in capturing information regarding any accident that may occur outside of the control of a PTC system as it is currently designed—including the prevention of collisions with trains not equipped with PTC systems—and accidents that could otherwise have been prevented by PTC technology, but were unanticipated by the system developers, the employing railroad, or FRA.

The data may be captured in the locomotive event recorder, or a separate memory module. If the locomotive is placed in service on or after October 1, 2009, the event recorder and memory module, if used, shall be crashworthy, otherwise known as crash-hardened, in accordance with § 229.135. For locomotives built prior to that period, the data shall be protected to the maximum extent possible within the limits of the technology being used in the event recorder and memory module.

One commenter stated that paragraph (d) was not clear. The commenter is unsure if FRA is requiring that all of the operator’s display be recorded and replicated upon playback. FRA only requires that the railroad capture the safety-critical data routed to the display which the engineer must obey. The choice of format to play back this data has been left to the railroad, keeping in mind that whatever format used for data playback needs to be available to FRA for accident investigations and other investigation activities.

As required by the RSIA08 and by paragraph (a)(1)(iv), as noted above, a PTC system required by subpart I must be designed to prevent the movement of a train through a main line switch in the wrong position. Paragraph (e) provides amplifying information on switch point monitoring, indication, warning of misalignment, and associated enforcement. According to the statute, each PTC system must be designed to prevent “the movement of a train through a switch left in the wrong position.” FRA understands “wrong position” to mean not in the position for the intended movement of the train. FRA believes that Congress’ use of the phrase “left in the wrong position” was primarily directed at switches in non-signaled (dark) territory such as the switch involved in the aforementioned accident at Graniteville, South Carolina. FRA also believes that, in order to prevent potential derailment or divergence to an unintended route, it is critical that all associated switches be monitored by a PTC system in some manner to detect whether they are in their proper position for train movements. If a switch is misaligned, the PTC system must provide an acceptable level of safety for train operations.

Prior to the statute, PTC provided for positive train separation, speed enforcement, and work zone protection. The addition of switch point monitoring and run through prevention would have eliminated the Graniteville, South Carolina accident where a misaligned switch resulted in the unintended divergence of a train operating on the main track onto a siding track and the collision of that train with another parked train on the siding. The resulting release of chlorine gas caused nine deaths and required the evacuation of the entire town for two weeks while remediation efforts were in progress.

As discussed above, FRA considered requiring PTC systems to be interconnected with each main line switch and to individually monitor each switch's point position in such a manner as to provide for a positive stop short of any misalignment condition. However, after further consideration and discussion with the PTC Working Group, FRA believes that such an approach may be overly aggressive and terribly expensive in signaled territory.

Under paragraph (e), FRA instead provides to treat switches differently, depending upon whether they are within a wayside or cab signal system—or are provided other similar safeguards (i.e., distant switch indicators and associated locking circuitry) required to meet the applicable switch position standards and requirements of subparts A-G — within non-signaled (dark) territory.

While a PTC system in dark territory will be required to enforce a positive stop—as discussed in more detail below—a PTC system in signaled territory will require a train to operate at no more than the upper limit of restricted speed between the associated signal, over any switch in the block governed by the signal, and until reaching the next subsequent signal that is displaying a signal indication more permissive than proceed at restricted speed.

Signaled territory includes various types of switches, including power-operated switches, hand-operated switches, spring switches, electrically-locked switches, electro-pneumatic switches, and hydra switches, to name the majority. Each type of switch poses different issues as it relates to PTC system enforcement. We will look at power- and hand-operated switches as examples.

On a territory without a PTC system, if a power-operated switch at an interlocking or control point were in a condition resulting in the display of a stop indication by the signal system, an approaching train will generally have to stop only a few feet from the switch, and in the large majority of cases no more than several hundred feet away from it. In contrast, in PTC territory adhering to the aforementioned overly aggressive requirement, a train will have to stop at the signal, which may be in close proximity to its associated switch, and operate at no more than the upper limit of restricted speed to that switch, where it would have to stop again. FRA believes that, since the train would be required to stop at the signal, and must operate at no more than the upper limit of restricted speed until it completely passes the switch (with the crew by rule watching for and prepared to stop short of, among other concerns, an improperly lined switch), a secondary enforced stop at the switch would be unnecessarily redundant.

Operations using hand-operated switches will provide different, and arguably greater, difficulties and potential risks. Generally, in between each successive interlocking and control point, signal spacing along the right of way can approximately be 1 to 3 miles or more apart, determined by the usual length of track circuits and the sufficient number of indications that would provide optimal use for train operations. Each signal governs the movement through the entire associated block up to the next signal. Thus, a train approaching a hand-operated switch may encounter further difficulties since its governing signal may be much further away than the governing signal for a power-operated switch. If within signaled territory a hand-operated switch outside of an interlocking or control point were in a condition resulting in the display of a restricted speed signal indication by the signal system, an approaching train may be required to stop before entering the block governed by the signal and proceed at restricted speed, or otherwise reduce its speed to restricted speed as it enters the block governed by the signal. The train must then be operated at restricted speed until the train reaches the next signal displaying an indication more permissive than proceed at restricted speed, while passing over any switch within the block. The governing signal, however, may be anywhere from a few feet to more than a mile from the hand-operated switch. For instance, if a signal governs a 3 mile long block, and there is a switch located 1.8 miles after passing the governing signal (stated in advance of the signal), and that switch is misaligned, the train would have to travel that 1.8 miles at restricted speed. Even if the train crew members were able to correct the misaligned switch, they would need to remain at restricted speed at least until the next signal (absent an upgrade of a cab signal indication).

In signaled territory, to require a PTC system to enforce a positive stop of an approaching train at each individual misaligned switch would be an unnecessary burden on the industry, particularly since movement beyond the governing signal would be enforced by the PTC system to a speed no more than the upper limit of restricted speed. Accordingly, in signaled territory, paragraph (e)(1) requires a PTC system to enforce the upper limit of restricted speed through the block. By definition, at restricted speed, the locomotive engineer must be prepared to stop within one-half the range of vision short of any misaligned switch or broken rail, etc., not to exceed 15 or 20 miles per hour depending on the operating rule of the railroad. Accordingly, if a PTC system is integrated with the signal system, and a train is enforced by the PTC system to move at restricted speed past a signal displaying a restricted speed indication, FRA feels comfortable that the PTC system will meet the statutory mandate of preventing the movement of the train through the switch left in the wrong position by continuously displaying the speed to be maintained (i.e., restricted speed) and by enforcing the upper limit of the railroads' restricted speed rule (but not to exceed 20 mph). While this solution would not completely eliminate human factors associated with movement through a misaligned switch, it would significantly mitigate the risk of a train moving through such a switch and would be much more cost effective.

Moreover, it would be cost prohibitive to require the industry to individually equip each of the many thousands of hand-operated switches with a WIU necessary to interconnect with a PTC system in order to provide a positive stop short of any such switch that may be misaligned. Currently each switch in signaled territory has its position monitored by a switch circuit controller (SCC). When a switch is not in its normal position, the SCC opens a signal control circuit to cause the signal governing movement over the switch location to display its most restrictive aspect (usually red). A train encountering a red signal at the entrance to a block will be required to operate at restricted speed through the entire block, which can be several miles in length depending on signal spacing. The signal system is not capable of informing the train crew which switch, if any, in the block may be in an improper position since none of switches are equipped with an independent WIU. There could be many switches within the same block in a city or other congested area. Thus, there is a possibility that one or more switches may be not in its proper position and the signal system would be unable to transmit which switch or switches are not in normal position. The governing signal could also be displaying a red aspect on account of a broken rail, broken bond wire, broken or wrapped line wire, bad insulated joint, bad insulated switch or gage rods, or other defective condition.

FRA believes that requiring a PTC system to enforce the upper limit of restricted speed in the aforementioned situations is statutorily acceptable. The statute requires each PTC system to prevent “the movement of a train through a switch left in the wrong position.” Under this statutory language, the railroad’s intended route must factor into the question of whether a switch is in the “wrong” position. In other words, in order to determine whether a switch is in the “wrong position,” we must know the switch’s “right position.” The “right position” is determined by the intended route of the railroad. Thus, when determining whether a switch is in the wrong position, it is necessary to know the railroad’s intended route and whether the switch is properly positioned to provide for the train to move through the switch to continue on that route. The intended route is normally determined by the dispatcher.

Under the final rule, when a switch is in the wrong position, the PTC system must have knowledge of that information, must communicate that information to the railroad (e.g., the locomotive engineer or dispatcher), and must control the train accordingly. Once the PTC system or railroad has knowledge of the switch’s position, FRA expects the position to be corrected in accordance with part 218 before the train operates through the switch. See, e.g., §§ 218.93, 218.103, 218.105, 218.107.

If the PTC system forces the train to move at no more than the upper limit of restricted speed, the railroad will have knowledge that a misaligned switch may be within the subject block, and the railroad, by rule or dispatcher permission, will then make the decision to move through the switch (i.e., the railroad’s intent has changed as indicated by rule or dispatcher instructions), so the switch will no longer be in the “wrong position.” The RSAC PTC Working Group was unanimous in concluding that these arrangements satisfy the safety objectives of RSIA08. Utilization of the signal system to detect misaligned switches and facilitate safe movements also provides an incentive to retain existing signal systems, with substantial additional benefits in the form of broken rail detection and detection of equipment fouling the main line.

Paragraph (e)(2) addresses movements over switches in dark territory and under conditions of excessive risk, even within block signal territory. In dark territory, by definition, there are no signals available to provide any signal indication or to interconnect with the switches or PTC system. Without the benefit of a wayside or cab signal system, or other similar system of equivalent safety, the PTC system will have no signals to obey. In such a case, the PTC system may be designed to allow for virtual signals, which are waypoints in the track database that would correspond to the physical location of the signals had they existed without a switch point monitoring system. Accordingly, paragraph (e)(2)(i) requires that in dark territory where PTC systems are implemented and governed by this subpart, the PTC system must enforce a positive stop for each misaligned switch whereas the lead locomotive must be stopped short of the switch to preclude any fouling of the switch. Once the train stops, the railroad will have an opportunity to correct the switch’s positioning and then continue its route as intended.

Unlike in signaled territory, FRA expects that on lines requiring PTC in dark territory, each switch will be equipped with a WIU to monitor the switch’s position. A WIU is a device that aggregates control and status information from one or more trackside devices for transmission to a central office and/or an approaching train's onboard PTC equipment, as well as disaggregating received requests for information, and promulgates that request to the appropriate wayside device. Most of the switches in dark territory are hand-operated with a much smaller number of them being spring and hydra switches. In dark territory, usually none of the switches have their position monitored by a SCC and railroads have relied on the proper handling of these switches by railroad personnel. When it is necessary to throw a main line switch from normal to reverse, an obligation arises under the railroad's rules to restore the switch upon completion of the authorized activity. Switch targets or banners are intended to provide minimal visual indication of the switch's position, but in the typical case trains are not required to operate at a speed permitting them to stop short of open switches. As evidenced by the issuance of Emergency Order No. 24 and the subsequent Railroad Operating Rules Final Rule (73 FR 8442; Feb. 13, 2008), proper handling of main line switches cannot be guaranteed in every case. However, now with the implementation and operation of PTC technology, if a switch is not in the normal position, that information will be transmitted to the locomotive. The PTC system will then know which switch is not in the normal position and require a positive stop at that switch location only.

In the event that movement through a misaligned switch would result in an unacceptable risk, whether in dark or signaled territory, paragraph (e)(2)(ii) requires the PTC system to enforce a positive stop on each train before it crosses the switch in the same manner as described above for trains operating in dark, PTC territory. FRA acknowledges that regardless of a switch's position, and regardless of whether the switch is in dark or signaled territory, movement through certain misaligned switches—even at low speeds—may still create an unacceptable risk of collision with another train.

FRA understands the term "unacceptable risk" to mean risk that cannot be tolerated by management (and in this case FRA can play the role of ensuring consistency).. It is a type of identified risk that must be eliminated or controlled. For instance, such an unacceptable risk may exist with a hand-operated crossover between two main tracks, between a main track and a siding or auxiliary track, or with a hand-operated switch providing access to another subdivision or branch line. The switches mentioned in paragraph (e)(2)(ii) are in locations where, if the switch is left lined in the wrong position, a train would be allowed to traverse through the crossover or turnout and potentially into the path of another train operating on an adjoining main track, siding, or other route. Even if such switches were located within a signaled territory, the signal governing movements over the switch locations, for both tracks as may be applicable, would be displaying their most restrictive aspect (usually red). This restrictive signal indication would in turn allow both trains to approach the location at restricted speed where one or both of the crossover switches are lined in the reverse position. Since the PTC system is not capable of actually enforcing restricted speed other than its upper limits, the PTC system would enforce a 15 or 20 mile per hour speed limit dependent upon the operating rules of the railroad. However, there is normally up to as much as a 5 mile per hour tolerance allowed for each speed limit before the PTC system will actually enforce the applicable required speed. Thus, in reality, the PTC system would not enforce the restricted speed condition until each train obtained a speed of up to 25 miles per hour. In this scenario, it is conceivable that two trains both operating at a speed of up to 25 miles per hour could collide with each other at a combined impact speed (closing speed) of up to 50 miles per hour. While these examples are provided in the rule text, they are merely illustrative and do not limit the universe of what FRA may consider an unacceptable risk for the purpose of paragraph (e). FRA emphasizes that FRA maintains the final determination as to what constitutes acceptable or unacceptable risk in accordance with paragraph (e)(2)(ii).

Caltrain submitted a comment recommending the removal of the following text from this section: "Unacceptable risk includes conditions when traversing the switch, even at low speeds, could result in direct conflict with the movement of another train (including a hand-operated crossover between main track, a hand-operated crossover between main track and an adjoining siding or auxiliary track, or a hand-operated switch providing access to another subdivision or branch line, etc.)" Caltrain asserted that the PTC Safety Plan is required to, and will address, whether a particular configuration is an acceptable risk. The examples cited can include a non-signaled siding or auxiliary track several feet below the grade of the mainline track. The possibility of the equipment on the auxiliary track conflicting with movement on the main line track is no greater at a crossover than if it is a single switch and turnout. Main to main crossovers are another topic which will be addressed in the risk analysis.

FRA believes it to be important to identify the requirement that a PTC system must enforce a positive stop short of any main line switch, and any switch on a siding where the allowable speed is in excess of 20 miles per hour, if movement of a train over such a switch not in its proper position could create an unacceptable risk. FRA is providing within the language of the rule example of movements through an improperly lined switch that FRA believes would result in unacceptable risk. This unacceptable risk is not related to the potential "roll-out" of equipment from another track onto the main track, which was referenced in the comment submitted by Caltrain, but constitutes any situation where a movement may diverge from one track onto an adjacent track potentially directly in front of a proceeding movement of a separate train on that track.

Furthermore, FRA provides in paragraph (e)(3) that a railroad may submit, with justification, alternative PTC system enforcement associated with unacceptable risk of train movements through improperly aligned switches in their applicable PTCDP or PTCSP for FRA approval. FRA therefore elects to leave the rule text of paragraph (e)(2)(ii) as it was written in the proposed rule.

The PTC system must also enforce a positive stop short of any misaligned switch on a PTC controlled siding in dark territory where the allowable track speed is in excess of 20 miles per hour. Sidings are used for meeting and passing trains and where those siding movements are governed by the PTC system, safety necessitates the position of the switches located on sidings to be monitored in order to protect train movements operating on them. Conversely, on signaled sidings, train movements are governed and protected by the associated signal indications, track circuits, and monitored switches, none of which are present in dark territory.

Paragraph (e)(3) notes that while switch position detection and enforcement must be accomplished, the PTCSP may include a safety analysis for alternative means of PTC system enforcement associated with switch position. Moreover, an identification and justification of any alternate means of protection other than that provided in this section shall be identified and justified. FRA recognizes that in certain circumstances, this flexibility may allow the reasonable use of a track circuit in lieu of individually monitored switches (addressing rail integrity as well as identification of open switches)..

Paragraph (e)(4) provides amplifying information regarding existing standards of subparts A through G of this part related to switches, movable-point frogs, and derails in the route governed that are equally applicable to PTC systems unless otherwise provided in a PTCSP approved under this subpart. This paragraph explains that the FRA required and accepted railroad industry standard types of components used to monitored switch point position and how those devices are required to function. This paragraph allows for some alternative method to be used to accomplish the same level of protection if it is identified and justified in a PTCSP approved under this subpart.

The AAR submitted comment that the language within paragraph (e)(4), which was presumably derived from subpart C of this part, prescribes conditions under which "movement authorities *can only be provided*." (emphasis added). The AAR contends that in the context of PTC design, this paragraph seems to prescribe a specific method (the withholding of movement authorities) to provide switch position protection per the requirements identified by paragraphs (e)(l) – (e)(3). The AAR asserts that paragraph (e)(4) should be clarified or revised to allow for PTC systems that may meet these requirements by methods other than, or in addition to, those methods prescribed by paragraph (e)(4). Thus, the AAR suggests rewording paragraph (e)(4) to read: "…unrestricted movement authorities can only be provided…."

FRA agrees with the principle of the AAR's comment. The intention appears to be that the permissiveness of *all* movement authorities over any switches, movable-point frogs, or derails must be determined by control circuits or their electronic equivalent selected through a circuit controller or functionally equivalent device that is operated directly by the switch points, derail, or switch locking mechanism, or through relay or electronic device controlled by such circuit controller or functionally equivalent device. *Unrestricted* movement authorities can only be provided when each switch, movable-point frog, or derail in the route governed is in proper position. FRA has therefore revised paragraph (e)(4) to read as follows: "(4) The control circuit or electronic equivalent for all movement authorities over any switches, movable-point frogs, or derails shall be selected through circuit controller or functionally equivalent device operated directly by switch points, derail, or by switch locking mechanism, or through relay or electronic device controlled by such circuit controller or functionally equivalent device, for each switch, movable-point frog, or derail in the route governed. Circuits or electronic equivalents shall be arranged so that any movement authorities *less restrictive than those prescribed in paragraphs (e)(1) and (e)(2) of this section* can only be provided when each switch, movable-point frog, or derail in the route governed is in proper position, and shall be in accordance with subparts A through G of this part, unless it is otherwise provided in a PTCSP approved under this subpart."

Paragraph (f) provides amplifying information for determining whether a PTC system is considered to be configured to prevent train-to-train collisions, as required under paragraph (a). FRA will consider the PTC system as providing the required protection if the PTC system enforces the upper limits of restricted speed. These criteria will allow following trains to pass intermediate signals displaying a restricting aspect and will allow for the issuance of joint mandatory directives.

Where a wayside signal displays a "Stop," "Stop and Proceed," or "Restricted Proceed" indication, paragraph (f)(1)(i) requires the PTC system to enforce the signal indication accordingly. In the case of a "Stop" or "Stop and Proceed" indication, operating rules require that the train will be brought to a stop prior to passing the signal displaying the indication. The train may then proceed at 15 or 20 miles per hour, as applicable according to the host railroad's operating rule(s) for restricted speed. In the case of a "Restricted Proceed" indication, the train would be allowed to pass the signal at 15 or 20 miles per hour. Some existing PTC systems do not enforce the stop indication under these circumstances, and FRA believes that this is acceptable. However, in either event, the speed restriction would be enforced until the train passes a more favorable signal indication. FRA agrees with NJT that, in dark territory where trains operate by mandatory directive, the PTC system would be expected to enforce the upper limit of restricted speed on a train when the train was allowed into a block already occupied by another preceding train traveling in the same direction. In freight operations, there may be situations where, in order to accomplish local switching, further latitude would be necessary, so long as the upper limit of restricted speed is enforced.

NJ Transit suggests that the FRA consider modifying the verbiage to more clearly define the expectation of the operating rules and enforcement requirements associated with the Stop and Proceed indication.

FRA fully understands the concern presented by NJ Transit, but suggests that the recommended modification to verbiage is already provided for in the language of paragraph (f)(1)(ii). FRA has therefore elected to retain the language of paragraph (f) in the final rule.

Paragraphs (g) through (k) all concern situations where temporary rerouting may be necessary and would affect application of the operational rules under subpart I. While the final rule attempts to reduce the opportunity for PTC and non-PTC trains to co-exist on the same track, FRA recognizes that this may not always be possible, especially when a track segment is out of service and a train must be rerouted in order to continue to destination. Accordingly, paragraph (g) allows for temporary rerouting of traffic between PTC equipped lines and lines not equipped with PTC systems. FRA anticipates two situations—emergencies and planned maintenance—that would justify such rerouting.

Paragraph (g) provides the preconditions and procedural rules to allow or otherwise effectuate a temporary rerouting in the event of an emergency or planned maintenance that would prevent usage of the regularly used track. Historically, FRA has dealt with temporary rerouting on an ad hoc basis. For instance, on November 12, 1996, FRA granted UP, under its application RS&I-AP-No. 1099, conditional approval for relief from the requirements of § 236.566, which required equipping controlling locomotives with an operative apparatus responsive to all automatic train stop, train control, or cab signal territory equipment. The conditional approval provided for "detour train movements necessitated by catastrophic occurrence such as derailment, flood, fire, or hurricane" on certain listed UP territories configured with automatic cab signals (ACS) or automatic train stop (ATS). Ultimately, the relief will allow trains not equipped with the apparatus required under § 236.566 to enter those ACS and ATS territories. However, the relief was conditional upon establishing an absolute block in advance of each train movement—as prescribed by General Code of Operating Rules (GCOR) 11.1 and 11.2—and notifying the applicable FRA Regional Headquarters. The detour would only be permissible for up to seven days and FRA could modify or rescind the relief for railroad non-compliance.

On February 7, 2006, that relief was temporarily extended to include defined territory where approximately two months of extensive track improvements were necessary. Additional conditions for this relief included a maximum train speed of 65 miles per hour and notification to the FRA Region 8 Headquarters within 24 hours of the beginning of the non-equipped detour train movements and immediately upon any accident or incident. On February 27, 2007, FRA provided similar temporary relief for another three months on the same territory.

While the aforementioned conditional relief was provided on an ad hoc basis, FRA feels that codifying rules regulating temporary rerouting involving PTC system track or locomotive equipment is necessary due to the potential dangers of allowing mixed PTC and non-PTC traffic on the same track and the inevitable increased presence of PTC and PTC-like technologies. Moreover, FRA believes that the subject railroads and FRA will benefit from more regulatory flexibility to work more quickly and efficiently to provide for temporary rerouting to mitigate the problems associated with emergency situations and infrastructure maintenance.

Under the final rule, FRA is providing for temporary rerouting of non-PTC trains onto PTC track and PTC trains onto non-PTC track. A train will not be considered rerouted for purposes of the conditions set forth in this section if it operates on a PTC line that is other than its "normal route," which is equipped and functionally responsive to the PTC system over which it is subsequently operated, or if it is a non-PTC train (not a passenger train or a freight train having any PIH materials) operating on a non-PTC line that is other than its "normal route."

Paragraph (g) effectively provides temporary civil penalty immunity from various applicable requirements of this subpart, including provisions under subpart I relating to lead locomotives, similar to how waivers from FRA have provided certain railroads immunity from § 236.566.

FRA expects that emergency rerouting will require some flexibility in order to respond to circumstances outside of the railroad's control—most notably changes in the weather, vandalism, and other unexpected occurrences—that would result in potential loss of life or property or prevent the train from continuing on its normal route. While paragraph (g) lists a number of possible emergency circumstances, they are primarily included for illustrative purposes and are not a limiting factor in determining whether an event rises to an emergency. For instance, FRA would also consider allowing rerouting in the event use of the track is prevented by vandalism or terrorism. While these events are not the primary reasons for which paragraph (g) would allow rerouting, FRA recognizes that they may fall outside of the railroad's control.

In the event of an emergency that would prevent usage of the track, temporary rerouting may occur instantly by the railroad without immediate FRA notice or approval. By contrast, the vast majority of maintenance activities can be predicted by railroad operators. While the final rule provides for temporary rerouting for such activities, the lack of exigent circumstances does not require the allowance of instantaneous rerouting without an appropriate request and, in cases where the request is for rerouting to exceed 30 days, FRA approval. Accordingly, under paragraph (g), procedurally speaking, temporary rerouting for emergency circumstances will be treated differently than temporary rerouting for planned maintenance. While FRA continues to have an interest in monitoring all temporary rerouting to ensure that it is occurring as contemplated by FRA and within the confines of the rule, the timing of FRA notification, and the approval procedures, reflect the aforementioned differences.

When an emergency circumstance occurs that would prevent usage of the regularly used track, and would require temporary rerouting, the subject railroad must notify FRA within one business day after the rerouting commences. To provide for communicative flexibility in emergency situations, the final rule provides for such notification to be made in writing or by telephone. FRA provides that written notification may be accomplished via overnight mail, e-mail, or facsimile. In any event, the railroad should take the steps necessary for the method of notification selected to include confirmation that an appropriate person actually on duty with FRA receives the notification and FRA is duly aware of the situation.

While telephone notification may provide for easy communications by the railroad, a mere phone call will not provide for documentation of information required under paragraph (g). Moreover, if for some reason the phone call is made at a time when the designated telephone operator is not on duty or if the caller is only able to leave a message with the FRA voice mail system, the possibility exists that the applicable FRA personnel would not be timely notified of the communication and its contents.

Emergency rerouting can only occur without FRA approval for fourteen (14) consecutive calendar days. If the railroad requires more time, it must make a request to the Associate Administrator. The request must be made directly to the Associate Administrator and separately from the initial notification sometime before the 14-day emergency rerouting period expires. Unless the Associate Administrator notifies the railroad of his or her approval before the end of the allowable emergency rerouting timeframe, the relief provided by paragraph (g) will expire at the end of that timeframe.

While a mere notification is necessary to commence emergency rerouting, a request must be made, with subsequent FRA approval, to perform planned maintenance rerouting. The relative predictability of planned maintenance activities allows railroads to provide FRA with much more advanced request of any necessary rerouting and allows FRA to review that request. FRA requires that the request be made at least 10 calendar days before the planned maintenance rerouting commences.

To ensure a retrievable record, the request must be made in writing. It may be submitted to FRA by fax, email, or courier. Because of security protocols placed in effect after the terrorist attacks of September 11, 2003, regular mail undergoes irradiation to ensure that any pathogens have been destroyed prior to delivery. The irradiation process adds significant delay to FRA's receipt of the document, and the submitted document may be damaged due to the irradiation process. Thus, FRA implores those making a rerouting request in writing to deliver the request through other, more acceptable, means.

The lack of emergency circumstances makes telephonic communication less necessary, since the communication need not be immediate, and less preferable, since it may not be accurately documented for subsequent reference and review. Like notifications for emergency rerouting, the request for planned rerouting must include the number of days that the rerouting should occur. If the planned maintenance will require rerouting up to 30 days, then the request must be made with the Regional Administrator. If it will require rerouting for more than 30 days, then the request must be made with the Associate Administrator. These longer time periods reflects FRA's opportunity to review and approve the request. In other words, since FRA expects that the review and approval process will provide more confidence that a higher level of safety will be maintained, the rerouting period for planned maintenance activities may be more than the 14 days allotted for emergency rerouting.

Regardless of whether the temporary rerouting is the result of an emergency situation or planned maintenance, the communication to FRA required under paragraph (g) must include the information listed under paragraph (i). This information is necessary to provide FRA with context and details of the rerouting. To attempt to provide railroads with the flexibility intended under paragraph (g), and to attempt to prevent enforcement of the rules from which the railroad should be receiving relief, FRA must be able to coordinate with its inspectors and other personnel. This information may also eventually be important to FRA in developing statistical analyses and models, reevaluating its rules, and determining the actual level of danger inherent in mixing PTC and non-PTC traffic on the same tracks.

For emergency rerouting purposes, the information is also necessary for FRA to determine whether it should order the railroad or railroads to cease rerouting or provide additional conditions that differ from the standard conditions specified in paragraph (i). FRA recognizes the importance of allowing temporary rerouting to occur automatically in emergency circumstances. However, FRA must also maintain its responsibility of ensuring that such rerouting occurs lawfully and as intended by the rules. Accordingly, the final rule provides the opportunity for FRA to review the information required by paragraph (g) to be submitted in accordance with paragraph (i) and order the railroad or railroads to cease rerouting if FRA finds that such rerouting is not appropriate or permissible in accordance with the requirements of paragraphs (g) through (i), and as may be so directed in accordance with paragraph (k), as discussed further below.

For rerouting due to planned maintenance, the information required under paragraph (i) is equally applicable and will be used to determine whether the railroad should not reroute at all. If the request for planned maintenance is for a period of up to 30 days, then the request and information must be sent in writing to the Regional Administrator of the region in which the temporary rerouting will occur. While such a request is self-executing—meaning that it will automatically be considered permissible if not otherwise responded to—the Regional Administrator may prevent the temporary rerouting from starting by simply notifying the railroad or railroads that its request is not approved. The Regional Administrator may otherwise provide conditional approval, request that further information be supplied to the Regional Administrator or Associate Administrator, or disapprove the request altogether. If the railroad still seeks to reroute due to planned maintenance activities, it must provide the Regional Administrator or Associate Administrator, as applicable, the requested information. If the Regional Administrator requests further information, no planned maintenance rerouting may occur until the information is received and reviewed and the Regional Administrator provides his or her approval. Likewise, no planned maintenance rerouting may occur if the Regional Administrator disapproves of the request. If the Regional Administrator does not provide notice preventing the temporary rerouting, then the planned maintenance rerouting may begin and occur as requested. However, once the planned maintenance rerouting begins, the Regional Administrator may at any time order the railroad or railroads to cease the rerouting in accordance with paragraph (k).

Requests for planned maintenance rerouting exceeding 30 days, however, must be made to the Associate Administrator and are not self-executing. No such rerouting may occur without Associate Administrator approval, even if the date passes on which the planned maintenance was scheduled to commence. Under paragraph (h)(3), like the Regional Administrator, the Associate Administrator may provide conditional approval, request further information, or disapprove of the request to reroute. Once approved rerouting commences, the Associate Administrator may also order the rerouting to cease in accordance with paragraph (k).

Paragraph (j) requires that, once temporary rerouting commences, regardless of whether it is for emergency or planned maintenance purposes, the track segments upon which the train will be rerouted must have an absolute block established in advance of each rerouted train movement and that each rerouted train movement shall not exceed 59 miles per hour for passenger and 49 miles per hour for freight.

Moreover, as referenced in paragraph (g) as it applies to both emergency and planned maintenance circumstances, the track upon which FRA expects the rerouting to occur will require certain mitigating protections listed under paragraph (j) in light of the mixed PTC and non-PTC traffic. While FRA purposefully intends paragraph (j) to apply similarly to § 236.567, FRA recognizes that § 236.567 does not account for the statutory mandates of interoperability and the core PTC safety functions. Accordingly, paragraph (j) must be more restrictive.

Section 236.567, which applies to territories where "an automatic train stop, train control, or cab signal device fails and/or is cut out en route," requires trains to proceed at either restricted speed or, if an automatic block signal system is in operation according to signal indication, at no more than 40 miles per hour to the next available point of communication where report must be made to a designated officer. Where no automatic block signal system is in use, the train shall be permitted to proceed at restricted speed or where an automatic block signal system is in operation according to signal indication but not to exceed medium speed to a point where absolute block can be established. Where an absolute block is established in advance of the train on which the device is inoperative, the train may proceed at not to exceed 79 miles per hour. Paragraph (j) utilizes that absolute block condition, which more actively engages the train dispatcher in managing movement of the train over the territory (in both signaled and non-signaled territory). Recognizing that re-routes under this section will occur in non-signaled territory, the maximum authorized speeds associated with such territory are used as limitations on the speed of re-routed trains. FRA agrees with the comments of labor representatives in the PTC Working Group who contend that the statutory mandate alters to some extent what would otherwise be considered reasonable for these circumstances.

It should be noted that this paragraph (j) was added by FRA after further consideration of this issue and was not part of the PTC Working Group consensus. FRA received several comments associated with the temporary rerouting requirements and the restrictive operational conditions imposed by paragraphs (j)(1) and (j)(2) as being overly burdensome, unsupported and inappropriate. Specifically, the idea that a train rerouted from a PTC line to a non-PTC line should be treated differently than the existing traffic on the non-PTC line is unjustified. The commenters suggest current FRA operational requirements contained in §§ 236.0(c) and (d) providing for speeds greater than 49 miles per hour for freight and 59 miles per hour for passenger trains where a block signal system and/or an automatic cab signal, automatic train stop, or automatic train control system is in place, is applied safely today and should continue as the applicable regulation for this reroute scenario. Thus, the commenters suggest rewording paragraph (j)(2) to read as follows: "Each rerouted train movement shall operate in accordance with § 236.0."

When the PTC Working Group was reconvened following the Public Hearing and the NPRM comment period, the PTC Working Group formed three separate task forces for the purpose of discussing and resolving several specific issues. One such task force, deemed the Operational Conditions Task Force, was assigned the task of resolving the issues associated with operational limitations presented in the proposed rule associated with temporary rerouting within § 236.1005, unequipped trains operating within a PTC system within § 236.1006, and en route failures within § 236.1029.

Following significant discussion of these issues, the Operational Conditions Task Force recommended rule text changes that would maintain the intended level of safety in an acceptable manner while recognizing the impractical nature and perhaps even resultant increase in risk associated with restricting the operation of a rerouted train from a PTC-equipped line onto a non-PTC equipped line more than other similarly equipped trains that normally operated on the non-PTC equipped line. Therefore, the task force recommended that paragraph (j) be revised to read as follows: "(j) Rerouting conditions. Rerouting of operations under paragraph (g) of this section may occur according to the following: (1) Where a train not equipped with a PTC system is rerouted onto a track equipped with a PTC system, it shall be operated in accordance with § 236.1029; (2) Where any train is rerouted onto a track not equipped with a PTC system, it shall be operated in accordance with the operating rules applicable to the line on which it is routed."

This recommended revision to paragraph (j) was presented to the PTC Working Group and gained consensus from the group. However, upon further consideration, FRA has decided to adopt a slight variation of the recommended revised rule text in order to provide additional clarification regarding the applicability of paragraph (j)(1) to either a train not equipped with a PTC system, or one not equipped with a PTC system that is compatible and functionally responsive to the PTC system utilized on the line on which the train is rerouted. Therefore, paragraph (j) has been revised in the final rule to read as follows: "(j) Rerouting conditions. Rerouting of operations under paragraph (g) of this section may occur under the following conditions: (1) Where a train not equipped with a PTC system is rerouted onto a track equipped with a PTC system, or a train not equipped with a PTC system that is compatible and functionally responsive to the PTC system utilized on the line to which the train is being rerouted, the train shall be operated in accordance with § 236.1029; or (2) Where any train is rerouted onto a track not equipped with a PTC system, the train shall be operated in accordance with the operating rules applicable to the line on which the train is routed."

Paragraph (k), as previously noted, provides the Regional Administrator with the ability to order the railroad or railroads to cease rerouting operations that were requested for up to 30 days. The Associate Administrator may order a railroad or railroads to cease rerouting operations regardless of the length of planned maintenance rerouting requested. FRA believes this is an important measure necessary to prevent rerouting performed not in accordance with the rules and FRA's expectations based on the railroad's communications and to ensure the protection of train crews and the public. However, FRA is confident that in the vast majority of cases railroads will utilize the afforded latitude reasonably and only under necessary circumstances.

FRA expects each host railroad to develop a plan to govern operations in the event temporary rerouting is performed in accordance with this section. Thus, as noted further below in § 236.1015, this final rule requires that each PTCSP include a plan accounting for such rerouted operations.

FRA has analyzed the costs and benefits below based on the deployment requirements of RSIA08 discussed above. FRA, for the reasons stated above, does not believe that a system of lesser extent than in the final rule would meet the minimum standards of the intent of Congress in RSIA08. A lesser system might have more favorable relationships between benefits and costs, but given that the do nothing alternative is apparently more favorable than the final rule, but also not in conformance with the intent of Congress, it does not make sense to perform further analysis of other possible regulatory schemes which also would fall short of meeting Congressional intent.

4.10 Section 236.1006, Equipping Locomotives Operating in PTC Territory

As reflected by § 236.566, the basic rule for train control operations is that all trains will be equipped with responsive on-board apparatus. Paragraph (a) so provided in the NPRM, and the language is continued in the final rule. Paragraph (a) requires that, as general rule, all trains operating over PTC territory must be PTC-equipped. In other words, paragraph (a) requires that each lead or controlling locomotive be operated with a PTC onboard apparatus if it is controlling a train operating on a track equipped with a PTC system in accordance with subpart I. The PTC onboard apparatus should operate and function in accordance with the PTCSP governing the particular territory. Accordingly, it must successfully and sufficiently interoperate with the host railroad's PTC system.

In the NPRM, FRA recognized the possibility of controlling locomotives not necessarily being placed in a train's lead position and sought comments on this issue. Comments were filed indicating that the lead locomotive is not always necessarily the controlling locomotive. In light of this information, the final rule reflects a change from "lead locomotive" to "controlling locomotive" as necessary. FRA's understanding of a "controlling locomotive" is the same understanding as it is used in part 232 and as defined in § 232.5. Hence, a definition as been added to § 236.1003 merely cross-referencing to § 232.5.

First, it is understood that during the time PTC technology is being deployed to meet the statutory deadline of December 31, 2015, there will be movements over PTC lines by trains with controlling locomotives not equipped with a PTC onboard apparatus. In general, Class I railroad locomotives are used throughout the owning railroad's system and, under shared power agreements, on other railroads nationally. FRA anticipates that the gradual equipping of locomotives—which will occur at a relatively small number of specialized facilities and which will require a day or two out of service as well as time in transit—will extend well into the implementation period that ends on December 31, 2015. It will not be feasible to tie locomotives down to PTC lines, and the RSAC stakeholders fully understood that point. The RLO did urge that railroads make every effort to use equipped locomotives as controlling units, and FRA believes that in general, railroads will do so in order to obtain the benefits of their investment.

The debate on this point has dealt with the possibility of exceptions, which was addressed in paragraph (b) in the NPRM. The discussion below pertains to the issue of temporary and permanent exceptions to the rule.

The first issue arose under paragraphs (b)(1) and (b)(2), which endeavored to set out the rules for the transitional period during which PTC will be deployed. It is well understood and accepted that it is not feasible to require all trains operating on a PTC line to be PTC-equipped and operative from the first day the system is turned on. Locomotive fleets will be equipped over a multi-year period, and deployment of locomotives will be driven by many factors, of which PTC status is only one. Efficient use of locomotives requires them to be available for use on multiple routes and even under “shared power” agreements with other railroads. In some cases, even when a PTC-equipped locomotive is placed in a consist destined for a PTC line there may be legitimate reasons why it is not placed in the lead position.

Accordingly, the NPRM provided what FRA thought was a very modest proposal that equipped locomotives placed in the lead on trains bound for PTC territory have their PTC equipment turned on. FRA even made allowance for a declining percentage of such locomotives being dispatched into PTC territory after having failed “initialization”. The reaction from Class I railroad commenters was startling, to say the least.

The AAR stated that the proposal was beyond FRA’s authority and has no ability to require use of PTC before December 31, 2015. According to AAR, railroads will be required to use PTC-equipped locomotives on PTC routes come December 31, 2015, and AAR does not understand how this obligation could be addressed in the implementation plan other than to state PTC-equipped locomotives would be used on PTC routes. In the AAR’s view, requiring PTC-equipped locomotives to be turned on would create a disincentive to equip locomotives early. Limiting the ability of railroads to operate trains with locomotives that fail initialization could result in railroads attempting to avoid rail system congestion by delaying the equipping of locomotives. To avoid such a disincentive for equipping locomotives, AAR believes that FRA should permit without limitation the operation of locomotives that fail initialization before December 31, 2015.

CSXT asserted that the requirements contained in paragraph (b)(2)(iii) with respect to the allowable percentage of controlling locomotives operating out of each railroad’s initial terminals with failed systems over track segments equipped with PTC will deter early implementation efforts and unfairly punish railroads that are diligently working to implement PTC on designated tracks. In addition, CSXT questioned the usefulness of such a provision, as CSXT argued that there is no meaningful difference between a locomotive that is not equipped with PTC and a locomotive that is equipped with a PTC system that is not fully functioning.

Recognizing that matching PTC lines with PTC-equipped controlling locomotives will be a key factor in obtaining the benefits of this technology in the period up to December 31, 2015, FRA requested comments on whether PTC Implementation Plans should be required to include power management elements describing how this will be accomplished to the degree feasible. In response, NJ TRANSIT asserted that the PTCIP does require both the Lines Risk Assessment (to establish the line segment order of PTC commissioning) and the schedule to equip rolling stock and suggests that these schedules can and should indicate the effort of a railroad to assure that vehicles are equipped and available for the PTC equipped lines. According to NJ TRANSIT, inclusion of a power management plan as well within the PTCIP provides an additional effort that has a high probability of requiring updates during the PTC implementation period, while the schedules and a good faith effort alone may serve the purpose most efficiently, especially for the short time period anticipated (this should be recognized as 2012 through 2015 at worst). NJ TRANSIT suggests that FRA should not include this plan as a PTCIP requirement, but require the best good faith effort by each railroad for providing equipped vehicles during the short interim period subject to this concern.

The AAR also stated that, for trains in long-haul service, the train's point of origin or location where the locomotive was added to the train may be many crew districts and/or hundreds or thousands of miles prior to the location where the locomotive's onboard PTC apparatus is initialized for operation in PTC-equipped territory. In this case, the paragraph is overly restrictive and should be modified to be predicated on the location prior to entering PTC-equipped territory where initialization failed. Accordingly, AAR suggests that paragraph (b)(2)(i) be revised to read: "The subject locomotive failed initialization at the point of crew origin for the train or at the location where the locomotive was added to the PTC initialized train."

The RLO also urges FRA to adopt a requirement that railroads place equipped engines in the lead or controlling position whenever such equipped engines are in the engine consist during the implementation period. The RLO states that implementing such consist management initiatives will help identify any problems in the interface of the onboard and wayside systems. In the future, states the RLO, railroad operations will come to rely heavily upon the proper function of these PTC systems. According to the RLO, requiring railroads to adopt this approach would require the minor operational maneuver of switching a trailing unit to the train's lead position. Since technical anomalies that go undetected can be catastrophic, the RLO asserts that FRA should not squander the opportunity for discovering them during the implementation period.

During the public hearing conducted on August 13, 2009, FRA specifically asked how the RLO expected a railroad to handle the situation where an engine that is PTC-equipped may be positioned with long hood forward or may have a broken air conditioning system. In its comments dated August 20, 2009, the RLO responded by stating that it is broadly accepted industry practice to operate trains with the short hood in the direction of movement. Operating trains with the long hood forward presents safety concerns because the engineer has a limited view of the railroad with that configuration. However, if any safety feature or safe practice is impaired, altered, or compromised in any locomotive, it should not be in the lead or operating position of the train.

Therefore, in the engine is not equipped with air conditioning or if the long hood is facing forward, the railroad would have three choices: grant the crew the right to switch a fully-compliant locomotive to the lead at the first location where this can be accomplished, do not operate at all, or remove the engine from the engine consist entirely. RLO asserts that this approach would create the safest possible working environment, as the safest locomotive is the one with PTC, AC, and the short hood forward.

GE asserts that, by using emerging technology, it is possible to operate a PTC system from the lead controlling locomotive using at least some parts of a PTC system on trailing locomotives in the consist if the onboard network is extended through the locomotive consist. According to GE, this can provide a useful contingent operation if some component fails in the lead locomotive and a backup component on a trailing unit is linked over the network, providing higher overall PTC availability. For example, should the data radio fail on the lead locomotive, PTC could continue to operate through a working radio on the second or third locomotive unit.

FRA agrees that PTC-equipped locomotives should be utilized when available on PTC territory during the implementation period, and it is recognized that it is possible for a unit to serve as the controlling locomotive when not positioned first in the consist. FRA believes that railroads have strong incentives to take advantage of their investments in PTC, but also includes in the final rule a requirement that the PTCIP include goals for PTC-equipped locomotives in PTC territory.

This issue was discussed further in the PTC Working Group during the review of comments, but no formal resolution was achieved. FRA is not obligated to provide any exception here whatsoever, and the contention that FRA may not require use of PTC prior to December 31, 2015 is utterly without merit. Nevertheless, FRA does not wish to proceed in such a manner as to create even a temporary disincentive to deploy PTC locomotives on PTC-equipped lines. However, clearly leaving the carriers to their own devices without accountability or oversight appears unwarranted given the tenor of their comments and the known conflicts among departments of the railroad that can arise during any implementation of new technology. Leaving the use of available PTC technology wholly unregulated until December 31, 2015, would not only open the possibility that safety gains would not be made during the period, it would also increase the possibility that PTC systems would not be sufficiently stable and reliable as of the statutory completion date.

Accordingly, FRA has included in the final rule, in lieu of the language initially proposed, a requirement that each railroad include in its PTCIP specific goals for progressively effective use of its equipped locomotives on PTC lines that have been made operational. FRA will review the goals and stated justification as part of its review of the PTCIP. The railroad will then be required to report annually its progress toward achieving its goals, including any adjustments required to remedy shortfalls. Although FRA does not intend to second guess details of power management, FRA does believe it is reasonable to expect results in the form of steadily declining PTC-preventable accidents during the implementation period. The only way to accomplish that is to ensure that PTC on-board apparatus is deployed on PTC lines in reasonable proportion to its deployment elsewhere and that, when so deployed, it is utilized as intended.

The second major issue arose under paragraph (b)(4), which proposed limited exceptions for movements of Class II and III trains over PTC lines of the Class I railroads. The disagreements attendant to that proposal warrant more detailed treatment.

New PTC systems will be like existing train control systems in the sense that they are comprised of onboard and wayside components. They will also involve a more substantial centralized “office” function. The railroad that has the right to control movements over a line of railroad (generally the entity providing or contracting for the dispatching function) will provide for equipping of the wayside and appropriate links to and interface with the office.

In preparing the recommendations that led to the NPRM, the PTC Working Group discussed at great length the issues related to operation of PTC-equipped locomotives, and locomotives not equipped with PTC onboard apparatus, over lines equipped with PTC. As explained above, the PTC Working Group recognized that the typical rule with respect to train control territory is that all controlling locomotives must be equipped and operative (see § 236.566). It was also noted in the discussion that the Interstate Commerce Commission (FRA's predecessor agency in the regulation of this subject matter) and FRA have provided some relief from this requirement in discrete circumstances where safety exposure was considered relatively low and the hardship associated with equipping additional locomotives was considered substantial. (For instance, in the case of intermittent automatic train stop installed many years ago on the former Atchison, Topeka and Santa Fe Railroad (now BNSF Railway), only passenger trains were subject to the requirement for on-board apparatus. That arrangement continues to the present day, and it is particularly unusual since none of the host railroad's locomotives are equipped, while all Amtrak locomotives operating over the territory must be equipped.)

The ASLRRA noted that its member railroads conduct limited operations over Class I railroad lines that will be required to be equipped with PTC systems in a substantial number of locations. These operations are principally related to the receipt and delivery of carload traffic in interchange. The small railroad service extends onto the Class I railroad track in order to hold down costs and permit both the small railroad and the Class I railroad to retain traffic that might be priced off the railroad if the Class I had to dispatch a crew to pick up or place the cars. This, in turn, supports competitive transportation options for small businesses, including marginal small businesses in rural areas.

The ASLRRA advocated an exception that would permit the trains of its members and other small railroads to continue use of existing trackage rights and agreements without the necessity for equipping their locomotives with PTC technology. They suggested that any incremental risk be mitigated by requiring that such trains proceed subject to the requirement for an absolute block in advance (similar to operating rules consistent with § 236.567 applicable to trains with failed onboard train control systems). This position was consistently opposed both by the rail labor organizations and the Class I railroads. These organizations took the position that all trains should be equipped with PTC in order to gain the benefits sought by the congressional mandate and to provide the host railroad the full benefit of its investment in safety. Informal discussions suggested that Class I railroads might offer technical or financial assistance to certain small railroads in equipping their locomotives, but that this would, of course, be done based on the corporate interest of the Class I railroad. (Although in general market forces and the public interest can be expected to correspond over time, this is not always the case. So, for instance, there is a risk that requiring all Class II and Class III railroads operating on Class I PTC lines to be equipped with PTC could be financially unsustainable absent a more generous division of the rate or other assistance (technical or otherwise) from the Class I interchange partner. A Class I railroad might respond to such situations based exclusively on the value of the traffic interchanged with respect to the transportation charge recovered for the long haul less costs. Although that might be a good market decision for the Class I railroad, the result could be loss of rail service for a rural community and diversion of the traffic to the highway—a result that might not be in the public interest. Over the past several decades the Federal Government and many of the States have made investments in light density rail service (through grants, loans, and/or tax concessions) that could be undermined should this occur.)

In the PTC Working Group and in informal discussions around its activities, Class I railroads indicated that they intended to take a strong position against non-equipped trains operating on their PTC lines, and that in order to enforce this restriction fairly, they understood that they would need to equip their own locomotives, including older road switchers that might venture onto PTC-equipped lines only occasionally. However, during these discussions, FRA was not able to develop a clear understanding regarding the extent to which the Class I railroads, under previously executed private agreements or because of a senior position derived from a prior transaction, enjoy the effective ability to enforce a requirement that all trains be equipped.

Proposed rule. On this question of non-equipped trains on PTC lines, the proposed rule represented a compromise position between the requests of the Class I and II railroads and the Class I railroads and labor organizations. It proposed to permit the practice only on territory where there was no scheduled intercity or commuter passenger service. On any given line segment, a particular Class II or III railroad could operate up to 4 trains per day (2 round trips) for up to 20 miles in perpetuity. For hauls in excess of 20 miles, the practice could continue until the end of 2020.

FRA offered this proposal in order to limit the burden on small entities and to avoid costs that were both avoidable and more greatly disproportionate to anticipated benefits than the basic requirements of the congressional mandate. FRA noted that the exceptions would constitute a small portion of the movements over the PTC-equipped line. FRA asserted that the accident/incident data show that the risk attendant upon these movements is small. As reflected in the NPRM, a review of the last seven years of accident data covering 3,312 accidents that were potentially preventable by PTC showed that there were only two of those accidents which involved a Class I railroad's train and a Class II or III railroad's train. (Left unstated in the NPRM was the fact that the presence of PTC would have prevented one of the accidents even absent equipping of the tenant train, while the other would not be prevented due to limitations of PTC architectures with respect to low-speed rear-end collisions.) FRA believed that the low level of risk revealed by these statistics justified an exception for Class II and III railroad trains traversing a PTC-equipped line for a relatively short distance. FRA noted that the cost of equipping those trains would be high when viewed in the context of the financial strength of the Class II or III railroad and the marginal safety benefits would be relatively low in those cases where a small volume of traffic is moved over the PTC-equipped line.

Comments on the NPRM Exceptions; FRA Response

None of the commenters responded directly to FRA's safety analysis, but they did take strong and disparate stands.

The Rail Labor Organizations (RLO) filed joint comments that protested allowing an unequipped train owned by a Class II or III railroad to move on PTC-required track with only minor restrictions. The RLO believed that there are alternatives that are consistent with safety and the intent of RSIA08, including temporal separation or using the host railroad's equipped locomotives. According to the RLO, simply limiting the number of moves and miles of unequipped locomotives on PTC-required track would not eliminate the risk associated with the hazard or provide compliance with the intent of RSIA08.

The AAR has also expressed concerns with the proposal, stating that "[s]urely Congress did not enact a requirement for the Class I railroads to spend billions of dollars on PTC systems only to permit Class II and III railroads to operate trains unequipped with PTC technology on the PTC routes. AAR asserts that FRA has not shown that there would actually be a financial strain on Class II and III railroads. According to AAR, a Class II or III railroad would not have to equip a locomotive with PTC technology until December 31, 2015. In any event, states AAR, the statute makes no distinction among Class I, II, or III operations on a PTC route.

CSXT disagreed with FRA's interpretation of RSIA08, stating that the statute, on its face, does not exempt Class II and III railroads from the PTC requirements. To the contrary, asserted CSXT, the statute appears to contemplate that Class II and III railroads traveling on PTC lines would be subject to the PTC requirements since each PTCIP for those lines "must provide for interoperability of the system with movements of trains of <u>other railroad carriers</u>," (emphasis original) which presumably includes Class II and III railroads. CSXT also questioned whether entities that carry a wide variety of commodities, including PIH traffic, but without the financial wherewithal to adopt PTC technologies, should be permitted to impose an arguably increased safety risk on the public and other railroads. In any event, stated CSXT, the Class II and III railroads would only be responsible for outfitting their locomotives, and not wayside units, with PTC technologies.

Moreover, according to CSXT, the exemption under proposed paragraph (b)(4)(B)(ii) was unclear as to its application This section allowed Class II and III railroads to operate on PTC operated track segments to the extent that any single railroad is allowed "less than four such unequipped trains" over any given track segment. CSXT questions whether the number of trains is limited per a common holding company or each railroad subsidiary. (The intent is that the limit will be applied to each separate railroad company, regardless of common ownership.)

Recognizing FRA's concerns with imposing the costs of PTC implementation on Class II and III railroads, AAR believes FRA is mixing up Congress' concern about the ability of Class II and III railroads to finance installation of PTC on their own routes with the ability of Class II and III railroads to operate locomotives equipped with PTC technology over Class I track. The AAR notes that FRA's own analysis shows that the cost of equipping locomotives with PTC technology amounts to less than a third of total PTC development and installation costs. According to AAR, a Class II or III railroad qualifying for the proposed exception likely would only need to equip only one or two locomotives with PTC technology by sometime after 2015.

In any event, AAR asserts that this proposed exemption for Class II and III railroads is inconsistent with the plain language of the statute, which does not distinguish between Class I, II, or III operations on a main line with TIH. Congress determined that PTC should be required on Class I routes meeting the statutory criteria regardless of any cost-benefit analysis. The AAR believes that it is inconceivable that Congress intended unequipped locomotives be permitted to operate routinely where PTC is required, thus undercutting the benefit of equipping a PTC route with PTC technology.

The AAR also challenges FRA's conclusion about the "marginal safety benefit," which seems premised on its analysis of train-to-train collisions, questioning whether FRA has concluded that a train operated by a Class II or III railroad poses less of a risk with respect to each of the core PTC functions than a train operated by a Class I railroad. Leaving aside AAR's objection to any exception permitting Class II and III railroads to conduct routine operations over PTC routes with unequipped locomotives, AAR does not agree with the proposal to wait until December 31, 2020, to impose the twenty-mile limitation. According to AAR, FRA has no factual basis for its concern that Class II and III railroads will be unable to obtain the technology as suppliers seek to equip their bigger Class I customers first. In fact, states AAR, it is more likely that Class I railroads will work with their Class II and III partners to prepare for the 2015 implementation deadline.

The Canadian Pacific Railway does not support the operation of unequipped locomotives on PTC equipped lines after December 31, 2015. It is CP's position that all trains operating on PTC territory after December 31, 2015, must be controlled by a locomotive equipped for PTC operation, regardless of whether or not the locomotive in the controlling position is considered "historic."

NYSMTA, the parent organization for the Long Island Rail Road and Metro-North Railroad, asserted that subpart I of this part should require all operators on the same trackage as commuter railroads to be fully equipped, as is the case in the existing FRA regulation, and that all trains (including those of all Class II and Class III tenant railroads) operating in cab signal/train control territory must have operative cab signal and ATC. Thus, NYSMTA suggested that Subpart I should not permit any trains to enter or operate in PTC territory that are not equipped with operative PTC systems except where en route failures occur within PTC territory. NYSMTA suggested that the definition of "equipped" for paragraphs (a) through (b)(3) be clarified to mean the onboard PTC system equipment has been fully commissioned, has passed all acceptance tests and has met reliability and availability demonstration tests. In the final rule, FRA continues to make clear that all trains operating on intercity/commuter passenger territory must be equipped.

FRA received a number of comments regarding the operation of historic locomotives over rail lines that will need to be equipped with a PTC system, from commenters such as the San Bernardino Railway Historical Society, the Pacific Southwest Railway Museum, the Railroad Passenger Car Alliance, and J.L. Patterson & Associates. These commenters requested that FRA provide clarification that a historic locomotive, as defined in 49 CFR 229.125(h), which is not equipped with PTC may be operated over rail lines equipped with PTC systems in limited excursion service, provided an excursion operating management plan is included in the PTC railroad's PTCIP that is consistent with the provisions of section 236.1029(b) of this part.

These locomotives might include steam locomotives many decades old. FRA notes that these operations are relatively infrequent, and the operations normally receive additional oversight by host railroads as a matter of course.

Final Rule. The final rule provides exceptions for trains operated by Class II and III railroads, including tourist or excursion railroads. The exceptions are limited to lines not carrying intercity or commuter passenger service, except where the host railroad and the passenger railroad (if different entities) have requested an exception in the PTC Implementation Plan, as further discussed below, and FRA has approved that element of the plan. Examples of potentially acceptable instances non-equipped operations on an intercity/commuter route might include a weekend excursion operation during periods scheduled passenger service is very light or in terminal areas under circumstances where all trains will be operated at reduced speed and risk is otherwise very limited.

FRA presumes for purposes of this final rule that there will be circumstances rooted in previously executed private agreements under which the Class I railroad would be entitled to require the small railroad to use a controlling locomotive equipped with PTC as a condition of operating onto the property. FRA wishes to emphasize that, in issuing this final rule, FRA does not intend to influence the exercise of private rights or to suggest that public policy would disfavor an otherwise legitimate restriction on the use of unequipped locomotives on PTC lines. FRA also notes that, in the absence of clear guidance on this issue, a substantial number of waiver requests could be expected that would have to be resolved without the benefit of decisional criteria previously examined and refined through the rulemaking process.

With respect to limited operations of Class II or III railroads on Class I PTC lines, FRA continues to believe that the risk in question is very small in relation to the direct and indirect costs of equipping locomotives with PTC and maintaining those locomotives over time (including configuration management). Although FRA does expect that over time Class II and III railroads will participate more fully in the use of PTC, both as tenants and hosts, the initial costs and logistical challenges of PTC operation will be significantly greater than the costs and challenges after interoperable PTC systems have been demonstrated to be reliable and after the market for PTC equipment and services settles. Mandating that every locomotive leading a Class II or III train be PTC equipped during the initial roll out would create significant incentives to shed marginally profitable traffic with unpredictable societal effects. FRA does believe that, as the end of the initial implementation approaches, smaller railroads can begin the process of joining the PTC community by equipping locomotives used for longer hauls on PTC lines. FRA will also review the experience of Class I railroads as of that general time period (end of 2015, beginning of 2016) to evaluate what additional requirements might be appropriate and sustainable.

FRA has adopted final language sufficiently flexible to permit occasional tourist, historic and excursion service on PTC lines. Much of the subject equipment is used very lightly and in fact may spend the great majority of its time on static display. Ending the educational and recreational role of occasional excursion service is no part of what the Congress was addressing through the mandate underlying this rule.

Paragraph (b)(3) references the fact that operation of trains with failed on-board PTC apparatus is governed by the safeguards of § 236.1029, where applicable; and **paragraph (c)** applies the same principle to non-equipped trains operating on PTC territory.

The costs and benefits of this section are included in the general analysis below. The added flexibility this may provide for small entities is a key part of FRA's compliance with the Regulatory Flexibility Act, as discussed below.

4.11 Section 236.1007, Additional Requirements for High-Speed Service

Since the early 1990's, there has been an interest centered around designated high speed corridors for the introduction of high speed rail, and a number of States have made progress in preparing rail corridors through safety improvements at highway-rail grade crossings, investments in track structure, and other improvements. FRA has administered limited programs of assistance using appropriated funds. With the passage of the American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 Stat. 115 (2009), which provides $8 billion in capital assistance for high speed rail corridors and intercity passenger rail service, and the President's announcement of a *Vision for High Speed Rail in America* in April of 2009, FRA expects those efforts to increase considerably. FRA believes that railroads conducting high speed operations in the United States can provide a world class service as safe as, or better than, any high speed operations being conducted elsewhere.

In anticipation of such service, and to ensure public safety, FRA proposed three tiers of requirements for PTC systems. The performance thresholds were intended to increase safety performance targets as the maximum speed limits increase to compensate for increased risks, including the potential frequency and adverse consequences of a collision or derailment. These thresholds were supported by AASHTO and are adopted as proposed.

Section 236.1007 sets the intervals for the high speed safety performance targets for operations with: maximum speeds at or greater than 60 and 50 miles per hour for passenger service and freight operations, respectively, under paragraph (a); maximum speeds greater than 90 miles per hour under paragraph (b); and maximum speeds greater than 125 miles per hour under paragraph (c) and maximum speeds greater than 150 mph in paragraph (d). The reader should note that the requirements are additive as speed rises. Thus, for instance, requirements above 90 miles per hour apply equally above 125 miles per hour and above 150 miles per hour.

Paragraph (a) addresses the PTC system requirements for territories where speeds are greater than 59 miles per hour for passenger service and 49 miles per hour for freight service. Under existing regulations (49 CFR § 236.0), block signal systems are required at these speeds (unless a manual block system is in place, an option that the final rule will phase out). The final rule expects covered operations moving at these speeds to have implemented a PTC system that provides, either directly or with another technology, all of the statutory PTC system functions along with the safety-critical functions of a block signal system. Track circuits assist in broken rail detection and unintended track occupancies (equipment rolling out). Fouling circuits can identify equipment that is intruding on the clearance envelope and may prevent raking collisions.

FRA recognizes that advances in technology may render current block signal, fouling, and broken rail detection systems obsolete and FRA does not want to preclude the introduction of suitable and appropriate advanced technologies. Accordingly, FRA believes that alternative mechanisms providing the same functionality are entirely acceptable and FRA encourages their development and use to the extent they do not have an adverse impact on the level of safety.

Paragraph (b) addresses system requirements for territories where operating speeds are greater than 90 miles per hour, which is currently the maximum allowable operating speed for passenger trains on Class 5 track. At these higher speeds, the implemented PTC system must not only comply with paragraph (a), but also be shown to be fail-safe (as defined in Appendix C) and at all times prevent unauthorized intrusion of rail traffic onto the higher speed line operating with a PTC system. FRA intends this concept of fail-safe application to be understood in its commonplace meaning; i.e., that insofar as feasible the system is designed to fail to a safe state, which normally means that trains will be brought to a stop.

Further, FRA understands that there are aspects of current system design and operation that may create a remote opportunity for a “wrong-side” or unsafe failure and that these issues would be described in the PTCSP and mitigations would be provided. FRA recognizes that, as applied in the general freight system, this provision could create a significant challenge related to interoperability of freight equipment operating over the same territory. Accordingly FRA requested comment on whether, where operations do not exceed 125 miles per hour or some other value, the requirement for compliance with Appendix C safety assurance principles might be limited to the passenger trains involved, with “non-vital” on-board processing permitted for the intermingled freight trains. No comments were received on this issue, apart from the general concern of the RLO that very safe technology be employed in all PTC systems, and the restriction is adopted as proposed.

As speed increases, it also becomes more important that inadvertent incursions on the PTC-equipped track be prevented. In this final rule, FRA expects that this be done by effective means that might include use of split-point derails properly placed, equipping of tracks providing entry with PTC, or arrangement of tracks and switches in such a way as to divert an approaching movement which is not authorized to enter onto the PTC line. The protection mechanism on the slower speed line must be integrated with the PTC system on the higher speed line in a manner to provide appropriate control of trains operating on the higher speed line if a violation is not prevented for whatever reason.

Paragraph (c) addresses high speed rail operations exceeding 125 miles per hour, which is the maximum speed for Class 7 track under § 213.307. At these higher speeds, the consequences of a derailment or collision are significantly greater than at lower speeds due to the involved vehicle's increased kinetic energy. In such circumstances, in addition to meeting the requirements under paragraphs (a) and (b), including having a fail-safe PTC system, the entity operating above 125 miles per hour must provide an additional safety analysis (the HSR-125) providing suitable evidence to the Associate Administrator that the PTC system can support a level of safety equivalent to, or better than, the best level of safety of comparable rail service in either the United States or a foreign country over the 5 year period preceding the submission of the PTCSP.

Additionally, PTC systems on these high speed lines must provide the capability, as appropriate, to detect incursion from outside the right of way and provide warnings to trains. Each subject railroad is free to suggest in its HSR-125 any method to the Associate Administrator that ensures that the subject high speed lines are corridors effectively sealed and protected from such incursions (see § 213.347 of this title), including such hazards as large motor vehicles falling on the track structure from highway bridges.

Paragraph (d) addresses the highest speeds existing or contemplated for rail operations exceeding 150 miles per hour. FRA expects these operations to be governed by a Rule of Particular Applicability and the HSR-125 required by paragraph (c) shall be developed as part of an overall system safety plan approved by the Associate Administrator.

The quantitative risk showing required above 125 miles per hour is not required to include consideration of acts of deliberate violence. The reason for this exclusion is simply to remove speculate or extraordinary considerations from the analysis. FRA and the Department of Homeland Security will of course expect that security considerations are taken into account in system planning.

AASHTO believed that the proposed rule appropriately addressed the PTC related safety levels for high speed rail. According to AASHTO, the proposed rule text provided a clear position for the levels of safety required for high speed rail at speeds that are achieved today, and for speeds that may be achieved in the future, allowing for benchmarking against precedent levels achieved in the U.S. and internationally. AASHTO also commented that in PTC systems running over federally designated high speed rail corridors, highway-rail grade crossings should either be eliminated or protected by hazard warning detection systems.

Amtrak notes that it currently operates safely above 90 miles per hour on the Northeast Corridor and on its Michigan line, with the full knowledge, approval, and authorization of the FRA, based on past and remaining safety procedures and equipment. Amtrak also states that it currently operates above 125 mph on portions of the Northeast Corridor. Accordingly, Amtrak asserts that services above 90 and 125 miles per hour that existed as of October 16, 2008, the date of RSIA08, should be exempted or "grandfathered" from the requirements of this section.

FRA agrees that Amtrak has been providing safe passenger service at speeds between 90 and 150 miles per hour on the Northeast Corridor as well as its Michigan line, and that the train control systems in use (ACSES with Cab Signals, and ITCS) have records of safe operations. Given the value of service experience and the extraordinary burden of review and decision making associated with this rule, FRA intends to give full credit to established safety records in conducting these reviews, simplifying the task for all concerned.

FRA does not believe that this section creates any new costs or benefits, as any high-speed system would have had a very reliable version of PTC.

4.12 Section 236.1009, Procedural Requirements

Section 236.1009 establishes the regulatory procedures that must be followed by each Class I railroad carrier and each entity providing regularly scheduled intercity or commuter rail passenger transportation to obtain the required FRA certification of PTC systems prior to operating the system or component in revenue service. FRA is implementing these requirements to support more rapid FRA review and decision making, while reducing the administrative burden on the railroads.

While the current subpart H of this part provides a technically sound procedure for obtaining FRA approval of various processor-based signal and train control systems, it was crafted with the presumption that PTC implementation was a strictly voluntary action on the part of railroads. Arguably FRA could have simply amended subpart H to include requirements relating to implementation plans and to modify the language to equate "approval" under subpart H with "certification" under the statute. However, FRA believes that such a resultant amended subpart H would still remain unsuitable to support the RSIA08 implementation schedule. Accordingly FRA has developed the new procedures of this section to avoid redundancy, provide sufficient flexibility to accompany the varying needs of those seeking certification and to mitigate the financial risk associated with technological investment necessary to comply with the regulatory requirements,

Generally speaking, there are three documents associated with the new procedures of this section: the PTCIP, PTCDP, and PTCSP. The details of each document are set forth in §§ 236.1011, 236.1013, and 236.1015, respectively. To summarize these sections, the PTCIP is the written plan that defines the specific details of how and when the railroad will implement the PTC system. The PTCDP provides a detailed discussion of the proposed technology and product that will be implemented according to the PTCIP. The PTCSP provides the railroad-specific information demonstrating that the PTC system, as implemented by the railroad, meets the required safety performance objectives. Certification of a PTC system by FRA for revenue operations is based on the review and approval of the information provided in these documents.

Paragraph (a) requires that a PTCIP be filed by "host" railroads as defined in § 236.1003 that are required to install a PTC system on one or more main lines in accordance with § 236.1005(b). This generally is each Class I railroad and each entity providing regularly scheduled intercity or commuter rail passenger transportation as defined by statute. However Class II and III railroads that host intercity or commuter rail service will also need to file implementation plans, whether or not they directly procure or manage installation of the PTC system.

Intercity and commuter railroads that are tenants on Class I, II, or III freight lines must also join with their host railroad in filing these plans. FRA believes that the railroad that maintains operational control over a particular track segment is generally in the best position to develop and submit the PTCIP, since that railroad is more knowledgeable of the conditions of, and operations over, its track. FRA recognizes that in cases where a tenant passenger railroad operates over a Class II or III railroad, that passenger railroad may be required to take a more active role in planning the PTC system deployment by working with the host railroad. In the case of an intercity or commuter railroad providing service over a Class I railroad, it may be sufficient for the passenger railroad to file a letter associating itself with the Class I railroad's plan to the extent it impacts the passenger service. AAR also expressed some confusion whether the requirement to file joint plans was only required when freight and passenger railroads conduct operations over the same route. The final rule does not levy any requirement for joint filing in the case where another railroad has freight trackage rights over a Class I railroad's PTC line. FRA expects that the host Class I railroad will address these types of operations and discuss the issue of interoperability in its

PTCIP as required by law.

The Class I railroads generally opposed the requirement for a host railroad and tenant passenger railroad to file a joint PTCIP as being excessively burdensome and unnecessary because it merely appears to be intended to address interoperability issues. Beyond possibly addressing the interoperability issue, the AAR maintained that nothing further would be gained by requiring the joint filing of PTCIP.

FRA has taken note of these objections. However, FRA believes that the joint filing requirement provides motivation for the proactive involvement by both parties in the decision-making process, especially with regards to interoperable equipment requirements and operating procedures. This joint filing requirement reflects FRA's position that communication between all parties involved in establishing interoperability is absolutely essential to ensure the implementation of timely, cost effective solutions.

Some railroads have also expressed concern that they will be required to support installation of PTC over Class II and III railroads that would otherwise not be required to implement PTC, were it not for the passenger/commuter railroad presence. Amtrak noted that the requirement for joint filings would, as a practical manner, require Amtrak to take a dominant role in the development and preparation of the required documentation.

While FRA appreciates the difficulties that both the passenger/commuter railroad, as well as the Class II or III railroad may experience, FRA believes that this is essentially a commercial matter between the parties involved, which would be best resolved with government participation only as a last resort. This position is consistent with the underlying philosophy of sections 151 through 188 of title 45 of the United States Code.

Although FRA believes that the resolution of differences between host and tenant railroads is a commercial issue, provisions have been made if a host freight railroad and tenant passenger railroad cannot come to an agreement to jointly file a PTCIP by April 16, 2010. In this situation each railroad must file an individual PTCIP, together with a notification to the Associate Administrator indicating that a joint filing was not possible and an explanation of why the subject railroads could not agree upon a final PTCIP for joint filing.

Both the freight and passenger/commuter railroads have strenuously objected to the assessment of civil penalties in the event that agreement cannot be reached. Amtrak claimed that failure to come to agreement did not rise to the level of an act that warranted penalty. AAR asserted that imposition of penalties would not be an appropriate way to resolve good faith disputes over the implementation of PTC. Concern has also been raised that, in the event of a dispute, the resolution process does not appear to have any established milestones. NYSMTA expressed concern related to the ability of railroads to fairly and quickly resolve disputes related to the development of host/tenant interoperability agreements required by RSIA08. NYSMTA asserted that even though FRA provides for dispute resolution in § 236.1009, there are no time limits or standards to ensure that disputes are resolved fairly and in a manner that does not affect railroads' ability to comply with the statutory/mandatory implementation of PTC by December 31, 2015.

FRA has taken note of these objections and concerns. FRA believes that the milestones are self-evident. Railroads are required to file implementation plans by April 16, 2010. Thus, failure to file an implementation plan (either jointly or individually) by April 16, 2010 constitutes a violation of the RSIA08. Railroads are also required to complete implementation by December 31, 2015. FRA does not intend to set any specific deadline for completion of mediation or arbitration other than to state that the mediation or arbitration must be resolved in time to allow both parties to complete the timely submission of their PTCIP by April 16, 2010 and to complete PTC installation by December 31, 2015.

FRA will exercise its prosecutorial discretion if railroads have unresolved conflicts, but have filed individual implementation plans in accordance with paragraph (a)(4) of this section and are engaged in good faith mediation or arbitration.

Caltrain requested clarification of the meaning of the term "confer", as used in paragraph (a)(4)(iv) of this section. During the conference process, FRA will request that all parties to the dispute advise FRA of where their differences arise, so that FRA can evaluate the potential impact on completion of the statutorily-required build out and understand the nature and extent of their disagreement. FRA may propose alternative solutions for consideration by both parties in the dispute. FRA is not, however, obligated to act as either a mediator or arbitrator of essentially commercial disputes. FRA expects that the disputing parties will submit such issues to a mutually acceptable mediator or arbitrator. If the disputing parties are unable to find a mutually agreeable private mediator or arbitrator, FRA may agree to mediate the dispute as a last resort. Otherwise, the disputing parties will need to seek judicial resolution of their issues.

It was also commented that if a PTCIP or request for amendment (RFA), as provided in § 236.1021, is submitted after April 16, 2010, in accordance with this rule, paragraph (a) does not provide the subject railroads with an opportunity to file separately. FRA intends, in such a situation, that if a railroad wishes to use track that would require the installation of a PTC system, and the parties have difficulty reaching agreement, then such usage would be delayed until the parties jointly file a mutually acceptable PTCIP and the jointly-filed PTCIP is approved by FRA. FRA notes that new passenger railroads are likely to begin operations during the period between issuance of this final rule and the end of the implementation period for PTC (December 31, 2015). Railroads that are required to install PTC, who intend to commence operations after April 16, 2010, but before December 31, 2015, would be expected to file a PTCIP that meets the requirements of paragraph (a) as soon as possible after the decision is made to commence operations. Any railroad commencing operations after December 31, 2015, that is required to install PTC, will not be authorized to commence revenue operations until the PTC installation is complete.

During review of the NPRM, AAR noted that paragraph (a)(2)(i) had not been updated to reflect an RSAC agreement. FRA agrees and has updated paragraph (a)(2)(i) to read, "…[a] PTCIP if it becomes a host railroad of a main line track that is required to implement and operate a PTC system in accordance with § 236.1005(b)..."

Paragraph (b) in the proposed rule required the submission of a PTCDP when the PTCIP was submitted to FRA for approval. Some railroads, primarily those owned and/or operated by government agencies, who submitted comments on this issue indicated that, while they would be able to identify the general functional requirements of the PTC system, they expected public procurement regulations would preclude contract award and identification of a particular vendor and the associated product details in time to meet the statutory submission deadline. They requested that FRA not require submission of the PTCDP at the same time (or before) the PTCIP. NYSMTA submitted comments asserting that simultaneous submissions would be problematic for LIRR. In view of the complexities and unknown factors associated with developing PTC solutions for LIRR's Dark and ABS Territories, and in light of its unique signaling applications and operating rules, LIRR was identified as being at high risk of non-compliance with the April 16, 2010 PTCDP submission deadline, despite its best efforts. Inasmuch as the RSIA08 does not explicitly stipulate a timeframe for a PTCDP, NYSMTA requested that the regulation be modified to allow for submission of a PTCDP after the April 16, 2010 deadline, at least with regard to Dark Territory and ABS Territories.

APTA submitted similar comments stating that the inclusion of the PTCDP or PTCSP in the April 2010 submission is problematic. Noting that submittal of these plans implies the selection of specific hardware and systems, APTA asserted that such submission is not possible given the current state of development of industry standards by the Railroad Electronics Standards Committee (RESC). Without available industry standards, APTA asserted that it would be impossible for the vast majority of public agencies that operate passenger rail systems to identify and contract with vendors or suppliers by the April 2010 deadline. Even though the freight railroads may have selected a proprietary technology as a basis for their PTC implementation, the competition standards for publicly funded contracts limit the ability of public agencies to follow a similar procurement strategy. Additionally, the lack of specific hardware and system standards to support interoperability further limits the ability of public agencies to enter into contracts by April 2010. Thus, if required to submit PTCDP and PTCSP documents by April 16, 2010, the documents would, of necessity, be incomplete and unacceptable.

APTA further claimed that the sole legislative requirement tied to April 2010 is for submission of the PTCIP. Thus, APTA believes FRA should allow submission of the PTCIP in a "product neutral" fashion to meet the statutory deadline and should defer submission of the PTCDP and PTCSP to allow flexibility and avoid incomplete submissions and the compilation and review of documents that cannot be approved.

Amtrak similarly expressed concern with the inadequate amount of time necessary to prepare the PTCIPs for its own NEC and Michigan Line and for the Class II and III railroads over which Amtrak operates (to the extent that those lines are not found to constitute other than "main lines") and to review those PTCIPs submitted by the Class I railroads and develop full PTCDPs. Because of the severe burden on Amtrak's resources, Amtrak recommended that the filing deadline for PTCDPs be extended at least 9 months beyond April 16, 2010.

As a government agency, FRA clearly understands the position faced by these railroads. However, FRA believes that a meaningful implementation plan cannot be created if a railroad has not identified and does not understand the technology it proposes to implement. Without this knowledge, it is not possible to have any informed discourse on system interoperability and implementation scheduling between railroads, vendors, and FRA. Therefore, in this final rule, FRA has provided several mechanisms that eliminate the need for each railroad to submit a PTCDP for a proposed PTC system, while still providing FRA sufficient information to carry out its regulatory responsibilities.

One such mechanism, as specified in paragraph (b) is through the use of a Type Approval. The Type Approval is a number assigned to a particular off-the-shelf or modified PTC system product—described in a PTCDP in accordance with § 236.1013—indicating FRA's belief that the product could fulfill the requirements of subpart I. FRA's issuance of a Type Approval does not mean that the product will meet the requirements of subpart I. The Type Approval applies to the technology designed and developed, but not yet implemented, and does not bestow any ownership or other similar interests or rights to any railroad. Each Type Approval number remains under the control of the FRA, and can be issued or revoked in accordance with this subpart.

FRA expects the Type Approval process to provide a variety of benefits to FRA and the industry. If a railroad submits a PTCDP describing a PTC system, and the PTC system receives a Type Approval, then other railroads intending to use the same PTC system without variances may, in accordance with paragraph (b)(1), simply rely on the Type Approval number without having to file a separate PTCDP. While the railroad filing the PTCDP must expend resources to develop and submit the PTCDP, all other railroads using the same PTC system would not. This should not only provide significant cost and time savings for a number of railroads, but should remove a significant level of redundancy from the approval process that is currently inherent in subpart H.

If, however, a railroad intends to use a modified version of a PTC system that has already received a Type Approval number, and the variances between the two systems are of a safety-critical nature, the railroad must submit a new PTCDP. The railroad may submit a new PTCDP that fully complies with the content requirements under § 236.1013 or supply a Type Approval number for the other PTC system upon which the modified PTC system will rely and a document that fulfills the content requirements under § 236.1013 with respect to the safety-critical variances between the system described within the original PTCDP and the system as modified.

The final rule does not preclude a railroad from submitting its PTCDP before its PTCIP for FRA review and approval. FRA encourages an earlier submission of the PTCDP to further reduce the required regulatory effort necessary to review the PTCIP and PTCDP if submitted together. More importantly, it would present an opportunity for FRA to issue a Type Approval for the proposed PTC system before April 16, 2010, thus providing other railroads intending to use the same or similar PTC system the opportunity to leverage off of the work already performed by simply submitting the Type Approval and—in the event of any variances—a much less burdensome PTCDP. FRA also believes this regulatory procedure may incentivize railroads using the same or similar PTC system to jointly develop and submit a PTCDP, thus further reducing the paperwork burden on FRA and the industry as a whole and increasing confidence in the interoperability between systems.

Vendors believe that FRA should type approve specific components, so the vendor may sell the type approved products. FRA believes that such a request may be based on the mistaken belief that FRA has adopted the FAA aviation model of type certifying aircraft frames, aircraft engines, and propellers (see 41 CFR Parts B-G). This is not, however, the case. FRA has adopted some elements of the FAA Airworthiness Certificate process (see 49 CFR Part 21, Subpart H), which addresses the suitability of an entire aircraft for a particular purpose. FRA will apply a similar standard and certify only complete PTC systems.

Another mechanism FRA is adding that will enable railroads to meet their statutory obligations in preparing and submitting a PTCIP, while providing enough information to FRA to facilitate FRA's evaluation of the technical feasibility of the PTCIP, can be found in the provisions of paragraph (c).

Paragraph (c) allows a railroad to file an abbreviated PTCDP, called a Notice of Product Intent (NPI) with their PTCIP. The NPI, detailed in § 236.1013(g), is handled in a manner similar to a full PTCDP, with certain key exceptions. First, a PTCIP may be submitted with a NPI in lieu of either a complete PTCDP (or reference to an approved Type Approval). Any PTCIP submitted with an NPI and approved by FRA will only receive a "Provisional Approval". The Provisional Approval will only be valid for a maximum period of nine months, by which time a railroad must resubmit their PTCIP with a complete PTCDP or reference to an approved Type Approval. If the railroad submits the updated PTCIP within the nine-month period, FRA will treat the updated filing in the same manner as FRA would have treated the original PTCIP submission. If the railroad fails to update the PTCIP before the end of the nine-month period, the Provisional Approval will automatically be revoked, and the revocation will be considered as retroactive to the original due date. FRA has no intention of extending any Provisional Approval beyond the nine-month period and will not entertain requests to that effect. Each railroad is expected to be capable of fully defining the product they intend to use within the nine-month period. Use of an NPI by a railroad allows for incremental, albeit limited, submission of the PTCDP.

Railroads would still be required to fully describe their plans for the use and completion of the PTCDP in their PTCIPs. Having the PTCDP development extend beyond the PTCIP due date may be beneficial to the entire industry, since it allows for practical development of PTC systems for railroads with unique technical requirements or financing restrictions while potentially increasing the number of viable suppliers, products, and systems. In addition to being practical, this approach would further the industry interests of having a more even distribution of the workload for commuter rail agencies and for FRA staff. Additionally, it enhances the ability of railroads to provide sufficient detail in the PTCDP, due to greater confidence in the overall design solution, thereby reducing the need for revision and the associated burden on FRA and railroad staff.

FRA clearly recognizes, regardless of the approach taken, that a vendor to the railroad may prepare part, if not all of the required documentation. Notwithstanding that fact, the railroad remains responsible for the completeness and accuracy of any documentation submitted. For instance, FRA may find that the PTCDP does not adequately conform to this subpart or otherwise has insufficient information to justify approval. FRA may also determine that there are issues raised by the PTCDP that would adversely affect the ability of FRA to eventually certify the system. If such a situation were to arise, the railroad would need to address the issues and resubmit the documentation for FRA approval.

The third mechanism available to railroads is described in paragraph (d). This paragraph allows railroads the opportunity to file a Request for Expedited Certification (REC) in lieu of an approved

PTCDP or a Type Approval, and the subsequent PTCSP developed in accordance with § 236.1015 in order to receive PTC System Certification. A REC applies only to PTC systems that have already been in revenue service and meet the criteria of § 236.1031(a). If a PTC system is not eligible for expedited certification, the railroad will be limited to the options presented in paragraphs (b) and (c).

Paragraph (e) requires that each PTCIP, PTCDP, and PTCSP must comply with the content requirements in §§ 236.1011, 236.1013, and 236.1015, respectively. If the submissions do not comply with their respective regulatory requirements, then they may not be approved. Without approval, a PTC system may not receive a Type Approval or PTC System Certification. Ultimately, PTC System Certification is FRA's formal recognition that the PTC system, as described and implemented, meets the statutory requirements and the provisions of subpart I. It does not imply FRA endorsement or approval of the PTC system itself.

Paragraph (e) also requires that all contents of the submitted plans be provided in the English language or translated into English and attested as true and correct. In the interest of an open market, FRA does not want to preclude the ability of PTC system suppliers outside of the United States from manufacturing PTC systems or selling them to the regulated railroads. However, in order to ensure the safety and reliability of those systems, FRA needs to be able to conduct an adequate review of the submitted plans. Accordingly, this final rule requires that all materials submitted in accordance with this subpart be in the English language, or be translated into the English language and attested as true and correct.

Under subpart H of this part, a railroad may seek confidential treatment for what it deems to be trade secrets, commercial, or financial information that is privileged or confidential under Exemption 4 of the Freedom of Information Act (FOIA), 5 U.S.C. 552(b)(4)— or the Trade Secrets Act (18 U.S.C. § 1905), and submit such requests in accordance with § 209.11. A railroad may request similar confidential treatment under subpart I. As with subpart H, should a FOIA request be made for information submitted under this rule for which the submitting party has requested confidential treatment, the submitting company will be notified of the request in accordance with the submitter consultation provisions of the Department's FOIA regulations (§ 7.17) and will be afforded the opportunity to submit detailed written objections to the release of information as provided for in § 7.17(a). FRA strongly encourages submitting parties to request confidential treatment only for those portions of documents that truly justify such treatment (i.e., trade secrets and security sensitive information).

While FRA continues to believe that there is no need at this time to substantially revise § 209.11, FRA will require an additional document to assist FRA in efficiently and correctly reviewing requests for confidentiality. Under § 209.11, a redacted and an unredacted copy of the same document must be submitted. When FRA review is required to determine whether confidentiality should be afforded, FRA personnel must painstakingly compare side-by-side the two versions to determine what information has been redacted. This process may result in information for which exemption from disclosure is being requested to be misidentified. To reduce this burden, and ensure that the intellectual property of the railroad and their suppliers is appropriately guarded, FRA requires that any material submitted for confidential treatment under subpart I and § 209.11 include a third version that would indicate, without fully obscuring, the redacted portions for which protection is requested. For instance, in order to indicate without obscuring the plan's redacted portions, the railroad may use the highlighting, underlining, or strikethrough functions of its word processing program. This document will also be treated as confidential under § 209.11. FRA could amend § 209.11 to include this requirement. However, FRA does not believe it to be necessary at this time.

FRA is allowing the submission of an adequate GIS shapefile to fulfill some of the PTCIP content requirements under § 236.1011. However, with respect to requesting confidential treatment of specific information contained in a GIS shapefile, which includes primarily map data, FRA recognizes that visually blocking out the information would defeat the purpose. For instance, a black dot over a particular map location, or a black line over a particular route, would actually reveal the location. Thus, FRA expects that a railroad seeking confidential treatment for portions of a GIS shapefile will submit three versions of the shapefile to comply with paragraph (e). FRA also expects that the version for public consumption would not include the information for which the railroad is seeking confidential treatment.

NICTD strongly urged FRA to only accept PTCIPs that provided full public disclosure of all the information needed to obtain components from multiple suppliers, including message interface standards, functional allocation for each subsystem, and safety allocation for each subsystem (e.g. identifying which hazards and safety-critical assumptions are made for each subsystem). NICTD asserted that it was not requesting proprietary information for any subsystems, but merely the ability to utilize alternative sources to fulfill the subsystem requirements within the overall PTC system. According to NICTD, this would substantially improve the likelihood of commuter railroads being able to obtain components from the multiple suppliers that are currently more than willing to develop components that will safely operate with other systems. Moreover, NICTD stated that this would facilitate compliance with interoperability requirements, as the knowledge gained would simplify development of interoperable systems and reduce procurement delays.

Amtrak agrees on the need for full public disclosure and asserts that it should be able to review and comment on the PTCIPs of the Class I railroads. FRA understands these positions, but FRA will not make any flat pronouncements about the confidentiality of information it has not yet received.

FRA expects that FRA-monitored laboratory or field testing or an independent third party assessment may be necessary to support conclusions made and included in a railroad's submitted PTCDP or PTCSP. This issue is addressed in paragraph (f). The procedural requirements to effectuate either of those requirements can be found in §§ 236.1035 and § 236.1017, respectively.

Paragraph (g) makes clear that FRA approval of a plan submitted under subpart I may be contingent upon any number of factors and that once the plan is approved, FRA maintains the authority to modify or revoke the resulting Type Approval or PTC System Certification. Under paragraph (g)(1), FRA reserves the right to attach additional requirements as a condition for approval of a PTCIP, or issuance of a Type Approval or PTC System Certification. In the preparation of any of these plans, railroads may have inadvertently failed to fully address hazards and risks associated with all of these components. FRA believes that paragraph (g)(1) will make the regulatory process more efficient and stable. Rather than reject a railroad's plan completely, and consequently delay the railroad's implementation of its PTC system, FRA would prefer to add additional conditions during the approval process to address these oversights. When determining whether to attach conditions to plan approval, FRA will consider whether: (1) the plan includes a well-defined and discrete technical or security issue that affects system safety; (2) the risk or safety significance of an issue can be adequately determined; (3) the issue affects public health and safety; (4) the issue is not already being processed under an existing program or process; and (5) the issue cannot be readily addressed through other regulatory programs and processes, existing regulations, policies, guidance, or voluntary industry initiatives.

Paragraph (g)(2) provides FRA the right to reconsider a Type Approval or a PTC System Certification as a consequence of the discovery of potential error, fraud or new information regarding system safety that was not previously identified. FRA issuance of each Type Approval or PTC System Certification under performance-based regulations assumes that the model of the train control system and its associated probabilistic data adequately accounts for the behavior of all design features of the system that could contribute to system risk. Different system design approaches may result in different levels of detail introducing different approximations/errors associated with the safety performance. There are some characteristics for which modeling methods may not fully capture the behavior of the system, or there may be elements of the system for which historical performance data may not be currently available. These potential inconsistencies in the failure analysis could introduce significant variations between the predicted and actual performances. Because of the design complexity associated with train control systems, FRA recognizes that these inconsistencies may not be the result of deliberate acts by any individuals or organizations, but simply reflect the level of analytical detail, the availability of comprehensive information, the qualification and experience of the analyst team, and the railroad's and FRA's resource limitations.

In paragraph (g)(3), FRA indicates that the railroad may be allowed to continue operations using the system, although such continued operations may have special conditions attached to mitigate any adverse consequences. It is FRA's intent, to the maximum extent possible and when consistent with safety, to assist railroads in keeping the systems in operation. FRA expects that if it places a condition on PTC system operations, each railroad will have a predefined process and procedure in place that would allow continued railroad operations, albeit under reduced capability, until appropriate mitigations are in place, and the system can be restored to full operation. In certain dire situations, FRA may actually order the suspension or discontinuation of operations until the root cause of the situation is understood and adequate mitigations are in place. FRA believes that suspending a Type Approval or a PTC System Certification pending a more detailed analysis of the situation may be appropriate, and that any such suspension must be done without prejudice. FRA expects to take such an action only in the most extreme circumstances and after consultation with the affected parties.

After reconsidering its issuance of a Type Approval or PTC System Certification, under paragraph (g)(4), FRA may either dismiss its reconsideration and continue to recognize the existing FRA approved Type Approval or PTC System Certification, allow continued operations with certain conditions attached, or order the railroad to cease applicable operations by revoking its Type Approval or PTC System Certification. If FRA dismisses its reconsideration and continues to recognize the Type Approval, any conditions required during the reconsideration period would no longer be applicable. If FRA will allow continued operations, FRA may order the continuation of conditions that were required during the reconsideration period and/or impose additional conditions. FRA expects that revocation of a Type Approval or PTC System Certification would occur in very narrow circumstances, where the risks to safety appear insurmountable. Regrettably, there may be a few situations in which the inconsistencies are the result of deliberant fraudulent representations. In such situations, FRA may also seek criminal or civil penalties against the entities involved.

APTA submitted comments asserting that the NPRM offered minimal guidance on what criteria FRA will use in accepting or rejecting a railroad's plan. Therefore, APTA asserted that FRA should draft and vet criteria that accomplishes the basic purposes of PTC, while allowing for innovation in meeting the performance requirements envisioned in the proposed regulation. FRA believes that this concern arises from the fact that this regulation, like Subpart H of this part, is a performance-based rule. While performance-based rules provide maximum flexibility to railroads and vendors, they also introduce a degree of ambiguity.

FRA, in consultation with the RSAC PTC working group, has developed and vetted model templates for both the PTCIP and the risk prioritization scheme to provide some degree of specificity without unnecessary constraints. It should be carefully noted that these templates are, by necessity, general in nature and must be customized by the individual railroad to reflect its individual operations. What may be applicable for one railroad may not be applicable to another. FRA has also provided vetted guidance as to acceptable design, verification and validation, and human factors in the appendices to this part. Again, given the wide variety of potential solutions that may be adopted by various railroads, FRA is reluctant to provide more detailed guidance. However, if a PTCIP content requirement under § 236.1011 is fulfilled in a submitted GIS shapefile, then the written PTCIP should simply cross-reference appropriately.

Paragraph (h) relates to FRA's authority to conduct inspections to ensure that a railroad is in compliance with subpart I. FRA inspections may be required to determine whether a particular railroad has implemented a PTC system where necessary. For instance, FRA may need to confirm whether a track segment is subject to five million gross tons or more of annual railroad traffic, PIH materials, or passenger traffic. FRA may also need to inspect locomotives to determine whether they are equipped with a PTC onboard apparatus or to review locomotive logs to determine whether the locomotive has entered PTC territory. Paragraph (h) simply reiterates FRA's statutory authority to inspect the railroads and gather information necessary to enforce its regulations.

In order to maintain an open marketplace, this final rule has been drafted to allow domestic railroads to purchase PTC systems from outside of the United States. FRA recognizes that PTC systems have been used in revenue service across the globe and that acceptable products may be available in other countries. FRA also recognizes that such use may fall under the jurisdiction of a foreign regulatory entity much like FRA. Accordingly, under paragraph (i), in the event information relating to a particular PTC system has been certified under the auspices of a regulatory entity in a foreign government, FRA is willing to consider that information as independently Verified and Validated to support the railroad's PTCSP development. The phrase "under the auspices" intends to reflect the possibility of certification contractually performed by a private entity on behalf of a foreign government agency. However, the foreign regulatory entity must be recognized by the Associate Administrator. A railroad seeking to enjoy the benefits of paragraph (i) must communicate that interest in its PTCSP, and is strongly encouraged to communicate such a desire well before submission of the PTCSP for approval.

Finally, the AAR noted that, unlike the precedent set by subpart H and the RSIA08, FRA did not include time frames for the agency to respond to the submissions of the PTCDP or PTCSP. The AAR urged FRA to include specific deadlines for these filings to ensure a common understanding of the time allotted to carry out the regulatory responsibilities. Accordingly, AAR proposed that FRA agree to respond within 60 and 120 days of the submission of a PTCDP and PTCSP, respectively. This 180-day approval period for both the development and safety plans is consistent with existing Subpart H, which allows 180 days for approval of a product safety plan.
FRA agrees that the railroads need, for their planning purposes, an estimated amount of time within which FRA will provide a response regarding the acceptability of their PTCSP submission.

FRA also believes that this information would be appropriately placed in § 236.1009. Accordingly, FRA is adding paragraph (j) to this section, which contains target deadlines for FRA review. FRA will acknowledge receipt of a PTCDP or PTCSP submission within 30 days. Depending upon the complexity of the system and the amount of participation by FRA in the PTCDP or PTCSP development process, FRA will endeavor to approve, approve with conditions, or deny approval of the PTCDP and PTCSP within 60 and 180 days, respectively. If FRA is unable to complete its review of the PTCDP or PTCSP within these estimated time periods, FRA will advise the submitter accordingly.

When reviewing the procedural requirements contained in the proposed rule, Labor expressed concern that this streamlined process may result in degradation of safety and significant concern with the ability of FRA to adequately staff the oversight process with a sufficient number of people with the requisite skill sets. FRA appreciates labor's concerns, and is undertaking plans to ensure that this new process does not result in any degradation of safety. FRA will continue to apply the same technical standards as used in earlier PTC system approvals. FRA has also taken steps to ensure that it has sufficient people, with the appropriate skills, to ensure proper safety oversight of this new process. A task analysis to determine the desired skills, as well as appropriate placement within the agency of additional staff members has been completed The RSIA08 authorizes an additional 200 full time positions to FRA, and FRA is ready to recruit the necessary technical staff as appropriations permit.

The costs and benefits of this section are included in the general analysis below. FRA believes that the submission and approval costs associated with meeting the requirements of subpart I are significantly less onerous than the submission and approval costs associated with meeting requirements equivalent to those in subpart H. Thus, FRA has attempted to minimize the procedural cost burden associated with obtaining PTC system certification.

4.13 Section 236.1011, PTC Implementation Plan Content Requirements

This section describes the minimum required contents of a PTC Implementation Plan. A PTCIP is a railroad's plan for complying with the installation of mandatory PTC systems required by

RSIA08 and administered by the Federal Railroad Administrator. The PTCIP consists of implementation schedules, narratives, rules, technical documentation, and relevant excerpts of agreements that an individual railroad will use to complete mandatory PTC implementation.

A PTCIP is an engineering document that must establish the railroad's commitment regarding how it will meet the PTC implementation requirements under RSIA08. FRA will measure the railroad's progress in meeting the required implementation date based on the schedule and other information in the PTCIP. While the final rule does not specify or mandate any specific organization for the PTCIP, it must at least clearly indicate which portions intend to address compliance with the various plan requirements under this section. The PTCIP must also clearly identify each referenced document and either include a copy of each document (or its applicable excerpt) or indicate where FRA and the public may view that document. Should FRA not be able to readily determine adequate response to the required information, FRA will assume that the information has not been submitted, and will handle the document accordingly. The lack of the required information may result in FRA's disapproval of a PTCIP.

To facilitate timely and successful submittals, FRA, through assistance from a PTCIP Task Force drawn from the PTC Working Group, developed a template that could be used to format the documents that must be submitted. FRA, however, wishes to emphasize that the use of such a template is strictly voluntary, and encourages railroads to prepare and submit the documents in whatever structure that is most economical for the railroad. FRA does not believe it is necessary to require that the railroads expend their limited resources in reformatting of documents when such an activity adds no real value. However, while the template may be a useful tool, and in light of the various forms a PTCIP may be required to take due to the system the railroad intends to implement, complete adherence to the template may not necessarily guarantee FRA approval of the submitted PTCIP.

FRA expects each PTCIP to include various highly specific and descriptive elements relating to each railroad's infrastructure and operations. FRA recognizes that to assemble manually each piece of data into a PTCIP may be exceptionally onerous and time consuming and may make the PTCIP prone to errors. In light of the foregoing and of the statutory requirement that Congress be apprised on the progress of the railroad carriers in implementing their PTC systems, FRA believes that electronic submission of much of this information may be warranted and preferred. To facilitate collection of this data, FRA requires submission of this data in electronic format. Such electronic submission would fulfill the requirements under § 236.1011 to which they apply.

FRA believes that the preferred, least costly, and least error-prone method to comply with § 236.1011 is for railroads to submit an electronic geographic digital system map containing the aforementioned segment attribute information in shapefile format, which is a data format structure compatible with most Geographic Information System (GIS) software packages. Using a GIS provides an efficient means for organizing basic transportation-related geographic data to facilitate the input, analysis, and display of transport networks. Railways around the world rely on GIS to manage key information for rail operations, maintenance, asset management, and decision support systems. FRA believes that the railroads may have already identified track segments, and their physical and operational characteristics, in shapefile format.

Accordingly, each shapefile document must provide the following identifiable information for each track segment: owning railroad(s); distance; signal system; track class; subdivision; number and location of sidings; maximum allowable speed; number and location of mainline tracks; annual volume of gross tonnage; annual number of cars carrying hazmat; annual number of cars carrying PIH; passenger traffic volume; average daily through trains; WIUs; switches; and at-grade rail-to-rail crossings. .

Paragraph (a) cites the minimum requirements that must be addressed in the PTCIP, but given the wide diversity of railroads and their operating environments, FRA recognizes that additional factors may come into play that reflect the unique operational characteristics of a particular railroad. It is beholden to each railroad to carefully analyze the circumstances associated with their operations and address any of these elements that may affect implementation planning. During its review of a PTCIP, FRA will carefully evaluate the plan to determine if the submitting railroad(s) have indeed addressed unique railroad issues. FRA wishes to make clear that in those situations, where additional factors that are unique to a railroad have not been addressed, FRA will return the PTCIP unapproved.

Paragraph (a)(1) requires that the railroad describe the technology that will be employed. Here, FRA intends to use the term "technology" broadly to include all applicable tools, machines, methods, and techniques.

Paragraph (a)(2) requires that the railroad describe how it will address fulfilling the requirements associated with the submittal of an NPI (see 49 CFR 236.1009(c)) temporarily in lieu of a PTCDP and the requirements associated with a PTCSP (see 49 CFR 236.1009(d)).

In RSIA08, § 20157(a)(2) requires that a railroad describe how it will "provide for interoperability of the system with movements of trains of other railroad carriers over its lines."
Practically speaking, this means that each locomotive operating within PTC territory must be able to communicate with, and respond to, the PTC systems installed on each PTC territory's track and signal system, except in those limited situations established elsewhere in this final rule. For this reason, paragraph (a)(3) requires that the PTCIP describe how the PTC system will provide for interoperability of the system between the host and all tenant railroads on the lines required to be equipped with PTC systems under this subpart.

Interoperability means the ability of diverse systems and organizations to work together (inter-operate), taking into account the technical, operational, and organizational factors that may impact system-to-system performance.   FRA expects each PTC system required by subpart I to exhibit syntactic interoperability—so that it may successfully communicate and exchange data with other PTC systems—and semantic interoperability—so that it may automatically, accurately, and meaningfully interpret the exchanged information to prove useful to the end user of each communicating PTC system. To achieve semantic interoperability, both sides must defer to a common information exchange reference model. In other words, the content of the information sent must be the same as what is received and understood. Taking syntactic and semantic interoperability together, FRA expects each PTC system to provide services to, and accept services from, other PTC systems and to use those services exchanged to enable the PTC systems to operate effectively together and to provide the intended results. The degree of interoperability should be defined in the PTCIP when referring to specific cases.

Interoperability is achieved through four interrelated means: product testing, industry and community partnership, common technology and intellectual property, and standard implementation.

Product testing includes conformance testing and product comparison. Conformance testing ensures that the product complies with an appropriate standard. FRA recognizes that certain standards attempt to create a framework that would result in the development of the same end product. However, many standards apply only to core elements and allow developers to enhance or otherwise modify products as long as they adhere to those core elements. Thus, if an end product is developed in different ways to conform to the same standard, there may still be discrepancies between each instantiation of the end product due to the existence of those variables. Accordingly, FRA believes that comparison testing must also occur to ensure that each instantiation of the same product, regardless of the means upon which it is created to meet the same standard, is ultimately identical. In regards to PTC systems, such comparison testing must occur on all portions that relate to each system's interoperability with other systems. Thus, it is also important that the PTC system be formally tested in a production scenario—as they will be finally implemented—to ensure that it will actually will intercommunicate and interoperate with other PTC systems as advertised and intended.

To reach interoperability between the various applicable PTC systems, each PTCDP must also show that the systems share common product engineering. Product engineering refers to the common standard, or a sub-profile thereof, as defined by the industry/community partnerships, specifically intended to achieve interoperability. Without common product engineering, the systems will be unable to intercommunicate or otherwise interact as necessary to comply with the final rule.

FRA expects that each interoperability standard for PTC systems will be developed by a partnership between various industry participants. Industry and community partnerships, either domestic or international, usually sponsor standard workgroups to define a common standard to provide system intercommunications for a specific purpose. At times, an industry or community will sub-profile an existing standard produced by another organization to reduce options and thus making interoperability more achievable. Thus, in each PTCDP, the railroad must discuss how it developed or adopted a standard commonly accepted by that partnership.

In the proposed rule, FRA noted that means of achieving interoperability include having the various entities involved using the same PTC system product or obtaining its components from the same developer.

In its comments, NICTD expressed its belief that this conclusion does not meet RSIA08's interoperability requirements. According to NICTD, while the freight railroads are free to choose their own supplier, their essential monopoly power has the potential to force commuter railroads to use the same supplier and thereby preventing commuter railroads from meeting the requirement to use open competitive bids from multiple suppliers for a system. Since the quantity of units required from the commuter railroads is substantially less than those required for the freight railroads, NICTD asserts this greatly reduces the ability of the commuter railroads to obtain system components that meet their specific operating needs, as the single supplier will not have the resources available to support those needs. NICTD also believes that this is in direct contrast with the FRA statement relating to performance standards: "FRA intends the proposed rule to accelerate the promotion of, and not hinder, cost effective technological innovation by encouraging an efficient utilization of resources, an increased level of competition, and more innovative user applications and technological developments."

Safetran also believes that each railroad should be free to choose a supplier. According to Safetran, the freight railroads through their implementation and development plans could specify a specific product or supplier preventing other railroads from using open competitive bids from multiple suppliers for a system and achieving the cost savings of competitive bidding. Safetran urges FRA to accept PTCIPs and PTCDPs that require public disclosure of all information needed to enable development of PTC components from multiple suppliers. This does not require disclosure of proprietary information, but does require disclosure of interface specifications as well as required functional attributes, assigned safety attributes and stimulus/response attributes.

While FRA does not necessarily require this approach—since the agency seeks to maintain an open and competitive marketplace—FRA believes that this is a suitable means to achieve interoperability. This technique may provide similar technical results when using PTC system products from different vendors relying on the same intellectual property. FRA recognizes that certain developers with an intellectual property interest in a particular technology may provide a non-exclusive license of its intellectual property to another entity so that the licensee may introduce into the marketplace a substantially similar product reliant on that intellectual property. In such a case, FRA foresees that the use of a common PTC system technology—even if it is proprietary to a single or multiple entities and licensed to railroads—could reduce the variability between components, thus providing for a more efficient means to achieve interoperability.

In order for interoperability to actually occur between multiple entities' PTC systems, there must be some standard by which they all adhere to. Thus, FRA also expects that each PTCDP will provide assurances of a common interoperability standard agreed to between all entities using PTC systems that must interoperate.

Since each of these interrelated means has an important role in reducing variability in intercommunication, each railroad's PTCIP must clearly describe the elements required under paragraph (a)(1)-(3).

During review of the NPRM, AAR noted paragraph (a)(3)(i) had not been updated to reflect an RSAC agreement. FRA agrees and has revised paragraph (a)(3)(i) to read: "… include relevant provisions of agreements, executed by all applicable railroads, in place to achieve interoperability." Much of the remaining information required in a PTCIP under the final rule relies on the location, length, and characteristics of each track segment. Therefore, a common understanding of a track segment is necessary. A track is the main designation for describing a physical linear portion of the network. Each line of railroad has a station location referencing system, which serves to locate inventory features and defects along the length of the track. Because some tracks can be very long, track segments are established to divide the track into smaller "management units." Typically, segment's boundaries are established at point of switch (POS) locations, but may also be located at mile markers, grade crossings, or other readily identifiable locations. Inspection, condition assessment, and maintenance planning is performed individually on each segment. After the track network hierarchy is established, the attribute information associated with each track is defined. This attribute information describes the track layout (e.g., curves and grades), the track structure (e.g., rail weights and tie specifications), track clearance issues, and other track related items such as turnouts, rail crossings, grade crossings, drainage culverts, and bridges. Inventory information about these track attributes can be quite detailed. The benefits of a complete and accurate track inventory is that it provides a record of the track network's properties and information about the existing track materials at the specific locations when maintenance or repair is necessary.

Paragraphs (a)(4) and (a)(5) together require the railroad to put its entire implementation plan into an understandable context, primarily as it relates to the sequence and schedule of track segment implementation events. Under RSIA08, Congress requires each subject railroad, in its PTCIP, to describe how it shall, to the extent practical, implement the PTC system in a manner that addresses areas of greater risk before areas of lesser risk. Accordingly, the PTCIP must discuss the railroad's areas of risk and the criteria by which these risks were evaluated and prioritized for PTC system implementation. To this end, the railroad must clearly identify all track segments that must be equipped, the basis for that decision for each segment (which might be done by categories of segments), and the implementation date for each segment will be completed, taking into account the time necessary to fulfill the procedural requirements related to PTCSP submission, review, and approval. At a minimum, the deployment decisions must be based on segment traffic characteristics such as passenger and freight traffic volumes, the quantity of PIH and other hazardous materials, current methods of operations, existence of block signals and other traditional train control technologies, the number and class of tracks, authorized and allowable speeds for each segment, and other unusual characteristics that may adversely impact safety, such as unusual ruling grades and other track geometries. In cases where deployment of the PTC system cannot be accomplished in order of areas with the greatest risk to areas with the least risk, paragraph (a)(9) requires that the railroad explain why such a deployment was not practical and the steps that will be taken to minimize adverse consequences to the public until the track segment can be equipped.

Paragraphs (a)(6) and (a)(7) require the PTCIP to include information regarding the rolling stock and wayside devices that will be equipped with the appropriate PTC technology. For a PTC system to work as intended, PTC system components must be installed and operated in all applicable offices and on all applicable onboard and wayside subsystems. Accordingly, the PTCIP must identify which technologies will be installed on each subsystem and when they are scheduled to be installed.

Under paragraph (a)(6), each host railroad filing the PTCIP must include a comprehensive list of all rolling stock upon which a PTC onboard apparatus must be operative. FRA understands that in most situations, the rolling stock referenced in paragraph (a)(6) may only apply to lead locomotives. However, in the interest of not hindering creative technological innovations, FRA presumes the possibility that PTC system technology may also be attached to additional rolling stock to provide other functions, including determining train capacity and length or providing certain acceptable and novel train controls. To be kept apprised of these possibilities, FRA is requiring in paragraph (a)(6) that each PTCIP include a list of all rolling stock equipped with PTC technology. FRA believes that the PTCIP should also identify any risks associated with trains operated by tenant railroads and not equipped with PTC system technology and the efforts that the host railroad has made to establish the extent of that risk.

FRA understands that a host railroad may not receive cooperation from a tenant railroad in collecting the necessary rolling stock information. Nevertheless, FRA expects each host railroad to make a good faith effort. Identification of those tenant railroads that the host railroad attempted to obtain the requisite and applicable information from and that failed to address a host railroad's written request may establish a good faith effort by the host railroad.

One railroad has requested that FRA eliminate the requirement for a power (locomotive) equipage plan in the PTCIP to avoid the need for updates to the PTCIP. Instead of requiring such a plan, the railroad recommends that FRA rely on railroad scheduling and good faith effort to drive installations during the period 2012 through 2015. FRA carefully considered this proposal, but has rejected it. Without an understanding of what portion of the locomotive fleet has been equipped and what portion remains to be equipped, FRA cannot accurately assess the extent to which PTC could be used in revenue service. FRA is required to make regular reports to Congress on the status of industry compliance and the operational capability of existing PTC systems. Since PTC is an integrated system, which requires both wayside and onboard equipment to be installed and operational, evaluation of the state of system deployment requires knowledge of the state of both subsystems.

Furthermore, the elimination of the equipage plan does not appear to provide any significant advantages to the railroad. Regardless of whether the railroad is required to maintain an equipage schedule for the PTCIP, or rely on railroad scheduling and good faith efforts, the railroad will still need to maintain some type of schedule to ensure the completion of required PTC installations by 2015. FRA believes that formalizing the schedule provides a planning tool that should facilitate completion of the installation process. If the equipage plan were unalterable, FRA could understand the railroad's concerns about being locked into an unrealistic and unobtainable schedule. However, FRA believes these concerns are unfounded because any plan in the PTCIP, including the equipage plan, can be adjusted to reflect changing circumstances.

Paragraph (a)(7) requires the railroad to provide the number of wayside devices required for each track segment in its PTCIP and an installation schedule for the completion of wayside equipment installation by December 31, 2015. The selection and identification of a technology selected as part of the PTCIP will also, to a great extent, determine the distribution of the functional behaviors of each of the PTC subsystems (e.g., office, wayside, communications, and back office). The WIU is a type of remote terminal unit (RTU) that is part of a larger PTC system, which is a type of Supervisory Control and Data Acquisition System (SCADA). As a whole, the safe and efficient operation of a SCADA—a centralized system that covers large areas, monitors and control systems, and passes status information from, and operational commands to, RTUs—is largely dependent on the ability of each of its RTUs to accurately receive and distribute the required information. As such, a PTC system cannot properly operate without properly functioning WIUs to provide and receive status information and react appropriately to control information.

It is commonly understood that a WIU device is capable of communicating directly to the office, train, or other wayside unit. FRA recognizes that there may not the same number of WIUs and devices that they monitor. Depending on the architecture and technology used, a single WIU may communicate the necessarily information as it relates to multiple devices. FRA is comfortable with this type of consolidation provided that, in the event of a failure of any one of the devices being monitored, the most restrictive condition will be transmitted to the train or office, except where the system may uniquely identify the failed device in a manner that will provide safe movement of the train when it reaches the subject location.

Because of the critical role that WIU's play in the proper and safe operation of PTC systems, paragraph (a)(7) requires that the railroad identify the number of WIU's required to be installed on any given track segment and the schedule for installing the WIU's associated with that segment. This information is necessary to fully and meaningfully fulfill the RSIA08 requirements that by December 31, 2012, Congress shall receive a report on the progress of the railroad carriers in implementing PTC systems. See 49 U.S.C. § 20157(d). To comply with this statutory requirement, each railroad must determine the number of WIUs it will need to procure and the location—as defined by the applicable subdivision—that each WIU will be installed. FRA believes that if a railroad does not perform these traditional engineering tasks, it will risk exceeding the statutory implementation deadline of December 31, 2015. FRA considers this information an integral part of the PTCIP that must be submitted to FRA for approval.

NYSMTA asserts that the requirement in paragraph (a)(7) to include the quantities of devices for each track segment in the PTCIP requires prior completion of the full design of the PTC system. However, NYSMTA asserts that it is not feasible to complete all of the survey and design necessary to meet this requirement by April 2010. Therefore, NYSMTA suggested that the requirement be reworded to read as follows: "Identification of each PTC subsystem and major assembly, and an estimated number of each required for each line segment ...."

FRA recognizes the potential for technological improvements that may modify the number and types of WIU's required. FRA also recognizes that during test and installation, it may be discovered that additional WIU installation may be necessary. In either case, the railroad will be required to submit an RFA in accordance with § 236.1021 indicating how the railroad intends to appropriately revise its schedule to reflect the resulting necessary changes. Nevertheless, regardless of whether FRA approves or disapproves of the RFA, if a railroad is required to submit its PTCIP by April 16, 2010, implementation must still be completed by the statutory deadline December 31, 2015.

One railroad recommended that paragraph (a)(7) should be revised to require railroads to identify each PTC subsystem and assembly and the estimated number of each subsystem required for each track segment. However, FRA does not believe that this change is required. First, FRA believes that the discussion of WIU requirements in paragraph (a)(7) is already generalized and implementation independent. Second, this final rule already provides for corrections in inventory count by submission of an RFA with the revised count. Therefore, FRA has not adopted this recommendation.

Under paragraph (a)(8), each railroad must also identify in its PTCIP which of its track segments are either main line or not main line. This list must be made based solely on the statutory and regulatory definitions regardless of whether FRA may later deem a track segment as other than main line. If a railroad has a main line that it believes should be considered not main line, it may file with the PTCIP a main line track exception addendum (MTEA) in accordance with § 236.1019, as further discussed below. Each track segment included in the MTEA should be indicated as much on the list required under paragraph (a)(8) so that the PTCIP accounts for each track segment with an appropriate cross-reference to the subject MTEA.

Paragraph (a)(9) requires that the plan call out the basis for a railroad's determination that risk-based prioritization required by paragraph (a)(4) of this section is not practical. FRA recognizes that there may be situations where risk is somewhat evenly distributed and where other factors related to practical considerations—such as the need to establish reliable operation of the system in less complex environments before installation in more complex environments—may be the prudent course. However, the burden of establishing the reasonableness of this approach would be on the railroad, starting with a showing that risk does not vary substantially among the track segments in question.

As mentioned elsewhere in this document, various railroads incorrectly asserted that they would not have to "turn on" their respective PTC systems until December 31, 2015. FRA recognizes that, although an approved PTCIP will include a progressive roll-out schedule, a PTC system cannot be operated in revenue service until it receives PTC System Certification. To avoid the possibility of a delayed plan submission that would frustrate the schedule, FRA has added paragraph (a)(10), which requires the railroad(s) to set its own due dates for such submissions. The ultimate due date, of course, is subject to FRA's approval of the PTCIP.

Paragraph (b) of § 236.1011 contains provisions related to further PTC deployment by the Class I railroads. As noted in the NPRM, the specific characteristics of the PTC route structure, with the focus on PIH traffic as an indicator of risk, was a late addition to the bill that would become RSIA08, not having appeared in either the House or Senate bills until the final package was assembled using consultations between the committee staffs in lieu of a formal committee of conference. Although the statutory construct (Class I rail line with 5 million gross tons and some PIH materials) adequately defines most of the core of the national freight rail system, it is a construct that will introduce distortions at both ends of the spectrum of risk.

On the one hand, a line with a maximum speed limit of 25 miles per hour ending at a grain elevator that receives a few cars of anhydrous ammonia is a "main line" if it has at least 5 million gross tons of traffic (a very low threshold for a Class I railroad). This is not a line without risk, particularly if it lacks wayside signals, but FRA analysis shows that the potential for a catastrophic release from a pressure tank car is very low at an operating speed of 25 miles per hour, and the low tonnage is likely associated with relatively infrequent train movements—limiting the chance of a collision. As FRA understands the congressional mandate, the law gives FRA little choice but to require PTC under these circumstances.

On the other end of the spectrum, lines with greater risk may go unaddressed. For instance, a line carrying significant volumes of other hazardous materials, without any PIH or passenger traffic, would not be equipped. This example is not likely to be present to any significant extent under current conditions. However, should the Class I railroads raise freight rates sufficiently to eliminate PIH traffic by making rail transportation prohibitively expensive, the issue would be presented as a substantial one. Most of the transportation risk—including hazards to train crews and roadway workers and exposure to other hazardous materials if released—would remain, but not the few carloads of PIH. FRA believes that the intent of the Congress with respect to deployment of PTC would be defeated, even though the minimum requirements related to passenger and PIH traffic would be satisfied.

Other lines carrying very heavy volumes of bulk commodities such as coal and intermodal traffic may or may not include PIH traffic. Putting aside the risk associated with PIH materials, significant risk exists to train crews and persons in the immediate vicinity of the right-of-way if a collision or other PTC-preventable accident occurs. Any place on the national rail system is a potential roadway work zone, but special challenges are presented in providing for on-track safety where train movements are very frequent or operations are conducted on adjacent tracks.

Risk on the larger Class II and III railroads' lines is also a matter of concern, and the presence of significant numbers of Class I railroad trains on some of those properties presents the opportunity for further risk reduction, since over the coming years virtually all Class I road locomotives will be equipped with PTC. Examples include trackage and haulage rights retained over Class II and III railroads following asset sales in which the Class Is divested the subject lines. Other prominent examples involve switching and terminal railroads, the largest of which are owned and controlled by two or more Class I railroads and function, in effect, as extensions of their systems. Conrail Shared Assets, a large regional switching railroad that is owned by Norfolk Southern and CSX and is comprised of major segments of the former Conrail, then a Class I railroad, is perhaps the classic example.

FRA notes that there has also been a trend, only recently and temporarily abated by the downturn in the economy, toward higher train counts on some non-signaled lines of the Class I railroads. On a train-mile basis, these operations present about twice the risk as similar operations on signalized lines. These safety gaps need to be filled; and, while most will be filled due to the presence of PIH traffic, FRA cannot verify that this is the case in every instance.

FRA concludes that the mandated deployment of PTC will leave some substantial gaps in the Class I route structure, including gaps in some major urban areas. FRA believes that these gaps will, over time, be "filled in" by voluntary actions of the Class I railroads as they establish the reliability of their PTC systems, verify effective interoperability, and begin to enjoy the safety and other business benefits from use of these systems. FRA fully understands both the desire of the labor stakeholders in the PTC Working Group to see a broader build-out of PTC systems than that "minimally" required by RSIA08 and the concerns of the Class I railroads' representatives who noted the extreme challenge associated with equipping tends of thousands of wayside units, some 20,000 locomotives, and their dispatching centers' back offices (back offices are the combined dispatch system and central office system associated with PTC) within the statutory implementation period.

The Congress recognized that all of these issues are legitimate concerns and so mandated the establishment of Risk Reduction Programs under the same legislation. Section 103 of RSIA08 codifies language that includes, within the Risk Reduction Program, a Technology Implementation Plan that is specifically required to address technology alternatives, including PTC. Accordingly, the PTC and Risk Reduction provisions in RSIA08 are clearly aligned in purpose; and there are also references in the technology plan elements of the Risk Reduction language that address installation of PTC by other railroads. Further, FRA has been charged with a separate rulemaking under section 406 of RSIA08 regarding risk in non-signaled (dark) territory that significantly overlaps the issue set in this rulemaking and the Risk Reduction section. Use of technologies that are integral to PTC constitute the best response to hazards associated with non-signaled lines. Switch position monitoring systems, track integrity circuits, digital data links and other technology used to address dark territory issues should be and, as presently conceived, are forward-compatible with PTC. FRA in paragraph (b) dovetails these requirements by requiring that each Class I railroad include in its PTCIP deployment strategies indicating how it will approach the further build-out of full PTC or partial PTC implementation. These railroads will then be required to include in the technology elements of their initial Risk Reduction plans a specification of which lines will be equipped and with what PTC system elements. Paragraph (b) makes clear that there will be no expectation regarding additional lines being equipped until those mandated by subpart I have been addressed. FRA shares the view of the Class I railroads and the passenger railroads that the December 31, 2015, deadline already presents a substantial challenge for railroads, suppliers and the employees affected.

One railroad objected to the requirement to describe the strategy and plan for complete build out and characterized it as premature, unwarranted, and inconsistent with the RSIA08. FRA strongly disagrees for the reasons previously set forth and has retained the requirement specified in paragraph (b).

Paragraph (c) codifies in regulation the statutory mandate that FRA review the PTCIP and determine, within 90 days upon receipt of the plan, whether to provide its approval or disapproval. FRA believes it is also important to provide procedural rules to communicate approval or disapproval. Thus, under paragraph (b), FRA provides that any approval or disapproval of a PTCIP requires FRA to provide written notice. In the event that FRA disapproves of the PTCIP, the notice will also include a narrative explaining the reasons for disapproval. Once the railroad receives notification that its PTCIP has been disapproved by FRA, it will have 30 days to resubmit its PTCIP for review and approval. While FRA may provide assistance to remedy a faulty PTCIP, it is ultimately the railroad's responsibility and burden to develop and submit a PTCIP worthy of FRA approval. FRA understands the railroads desire to extend the period of time for corrections of any issues in the PTCIP, especially in circumstances that the railroad believes are out of its control. However, the 30-day period is a statutory requirement. FRA has little leeway in this regard. FRA will try to work, within the limits of available FRA resources, with railroads in reviewing draft versions of the PTCIP before April 16, 2010. Early identification of potential issues should reduce, and possibly eliminate, rework that a railroad might need to address during the 30-day correction period. However, regardless of any early FRA participation in the document review cycle, the railroad is expected to submit a plan that requires little to no rework.

A number of comments were submitted objecting to the potential assessment of civil penalties based on a railroad's failure to timely file a PTCIP. While FRA is unwilling to revise its position on this issue, FRA will exercise prosecutorial discretion in the assessment of civil penalties.

APTA submitted comments suggesting that the language in paragraph (c) of this section be amended to allow at least 90 days – the time allotted for FRA plan review – for railroads to correct deficiencies and re-submit their plans. In a similar vein, NYSMTA submitted comments asserting that the amount of time allotted to correct deficiencies should be based on to the extent of the needed correction. On the other hand, NYSMTA proposed that penalties could be involved if railroads submit plans deemed to be superfluous. Again, the law requires that both the railroads and FRA work quickly to get plans in place. As the entity at the receiving end of multiple filings, FRA will no doubt have every reason to handle these matters with a spirit of cooperation where best efforts have been made to fulfill the statutory requirements.

As noted previously, subpart I applies to each railroad that Congress and FRA has mandated to install a PTC system. A railroad that is not required to install a PTC system may still do so under its own volition. In such a case, it may either seek approval of its system under either subpart H or I. Paragraph (d) intends to make this choice clear.

Paragraph (e) responds to comments by labor organizations in the PTC Working Group. These employee representatives sought the opportunity to comment on major PTC filings. Paragraph (e) provides that, upon receipt of a PTCIP, NPI, PTCDP, or PTCSP, FRA will post on its public website notice of receipt and reference to the public docket in which a copy of the filing has been placed. FRA may consider any public comment on these documents to the extent practicable within the time allowed by law and without delaying implementation of PTC systems. The version of any filing initially placed in the public docket, for which confidential treatment has been requested in accordance with § 209.11, will be the redacted copy as filed by the railroad. If FRA later determines that additional material was not deserving of confidential treatment, that material will be subsequently added to the docket.

Paragraph (f) has been added to this section in the final rule to require railroads to maintain their most recent PTC deployment plans in their PTCIPs until all PTC system deployments required under the RSIA08 have been completed.

The costs and benefits of this section are included in the general analysis below. The MTEA provisions may grant important flexibility to small entities.

4.14 Section 236.1013, PTCDP Content Requirements and Type Approval

As noted in the discussion above regarding § 236.1009, each PTCSP must be submitted with a Type Approval number identifying a PTC system that FRA believes could fulfill the requirements of subpart I. Under § 236.1009, a railroad may submit an existing Type Approval number in lieu of a PTCDP if the PTC system it intends to implement and operate is identical to the one described in that Type Approval's associated PTCDP. In the event, however, that a railroad intends to install a system for which a Type Approval number has not yet been assigned, or to use a system with an assigned Type Approval number that may have certain variances to its safety-critical functions, then the railroad must submit a PTCDP to obtain a new Type Approval number.

The PTCDP is the core document that provides the Associate Administrator sufficient information to determine whether the PTC system proposed for installation by the railroad could meet the statutory requirements for PTC systems specified by RSIA08 and the regulatory requirements under subpart I. Issuance of a product Type Approval number is contingent upon the approval of the PTCDP by the Associate Administrator. While filing of a PTCDP is optional in the sense that the railroad may proceed directly to submission of the PTCSP by the April 16, 2010 deadline (see § 236.1009), FRA encourages railroads engaged in joint operations to do so. Approval of the PTCDP, and issuance of a Type Approval, presents the opportunity for other railroads to reduce the effort required to obtain a PTC System Certification. If a Type Approval for a PTC system exists, another railroad may also use that Type Approval provided there are no variances in the system as described in the Type Approval's PTCDP. In such cases, the other railroad may avoid submitting its own PTCDP by simply incorporating by reference the supporting information in the Type Approval's PTCDP and certifying that no variances in the PTC system have been made.

This section describes the contents of the PTCDP required to obtain FRA approval in the form of issuance of a Type Approval number. The provisions of this section require each PTCDP to include all the elements and practices listed in this section to provide reasonable assurance that the subject PTC system will meet the statutory requirements and are developed consistent with generally-accepted principles and risk-oriented proof of safety methods surrounding this technology. FRA believes it is necessary to include the provisions contained in this section in order to provide reasonable assurance that the product, when developed and deployed, will have no adverse impact on the safety of railroad employees, the public, and the movement of trains.

FRA recognizes that much of the information required by § 236.1013 normally resides with the PTC system's developer or supplier maintains and not the client railroad. While FRA expects that each railroad and its PTC system supplier may jointly draft a PTCDP, the railroad has the primary responsibility for the safety of its operations and for providing the information required under § 236.1013. Accordingly, each railroad required to submit a PTCDP under subpart I should make the necessary arrangements to ensure that the requisite information is readily available from the supplier for submission to the agency.

FRA believes that suppliers and railroads will develop a PTCDP for most products that adequately address the requirements of the new subpart without substantial additional expense. As part of the design and evaluation process, it is essential to ensure that an adequate analysis of the features and capabilities is made to minimize the possibility of conflicts resulting from any use or feature, including a software fault. Since this analysis is a normal cost of software engineering development, we do not believe it imposes any additional significant costs beyond what should already be done when developing safety critical software.

The passenger and public commuter railroads who submitted comments expressed significant concern that the Class I railroads' choice of a single vendor or supplier for the onboard components of the PTC systems, coupled with the RSIA08 requirement for interoperability, creates a de-facto monopoly, with associated adverse impacts on costs and schedule. These commenters recommended that FRA take positive steps to ensure that sufficient information is made available to allow the railroads to source components from multiple vendors or suppliers. The suggested actions ranged from disapproving any PTCIP/PTCDP that is not based on open standards to expediting Interoperable Train Control (ITC) specification documentation.

FRA appreciates the concerns expressed regarding a de-facto monopoly and the possible adverse consequences on system deployments. FRA, however, must defer to the Departments of Justice and Commerce regarding issues of alleged monopolistic behavior.

FRA has, in Subpart H of this part, and continues in Subpart I, to encourage use of publicly available standards in the design, implementation and test of PTC systems. FRA does not mandate the use of any particular standard by a railroad, vendor or supplier, but rather has adopted a policy of allowing the marketplace to decide what standard(s) should be used, provided the end result – a suitable safe product – is obtained. Specification of government standards is only appropriate where there has been a failure of the marketplace. It has not yet been established that such marketplace failure has occurred. Even if such a marketplace failure were deemed to have occurred, it is extremely unlikely that FRA would be able to complete the development of appropriate standards before current industry efforts with the ITC specifications are finalized and made publicly available. FRA understands the railroads' concerns and will monitor the situation.

FRA hastens to add that, since the publication of the NPRM, it has become clear that ITC standards may not be completed and validated prior to the end of 2010. FRA has requested that the ITC railroads accelerate this process in the interest of compliance with the law, and has added the Notice of Product Intent as a means of bridging to the point where standards are available. Looking forward to mid-2010, FRA will assess the situation with respect to delivery of open standards and their adoption by the AAR. Should it appear that a timely delivery will not be made, FRA reserves the right to take further regulatory action. That action could include a proposal for adoption of mandatory interoperability standards, likely in the form of existing American Railway Engineering and Maintenance Association standards that have already been developed through the leadership of the major international signal suppliers. FRA believes that such action should not be necessary and looks forward to the timely completion of ITC standards.

One vendor pointed out that a significant portion of the work associated with PTC system is commercially sensitive. FRA is committed to appropriate protection of both railroad and vendor intellectual property. Its development is recognized as representing the expenditure of significant resources by the vendor, the railroad, or both. However, interoperability requirements between railroads require some disclosure of information between railroads and vendors or suppliers. This should not require disclosure of proprietary information, but does require disclosure of interface specifications, as well as required functional attributes, assigned safety attributes and stimulus/response attributes. FRA believes such disclosure of the latter is in the best interest of the railroad, vendor, and supplier communities and strongly encourages the free exchange of this information.

In §§ 236.1013 and 236.1015, various adjectives precede several of the requirement. For instance, certain paragraphs require “a complete description,” “a detailed description,” or simply a “description.” These phrases are inherited from subpart H. Their inclusion in subpart I are similarly not to imply that any description should be more or less detailed or complete than any other description required. By contrast, they are included merely for the purposes of emphasis.

Paragraph (a)(1) requires that the PTCDP include system specifications that describe the overall product and identify each component and its physical relationship in the system. FRA will not dictate specific product architectures, but will examine each PTC system to fully understand how its various parts interrelate. Safety-critical functions in particular will be reviewed to determine whether they are designed to be fail-safe. FRA would like to emphasize that the PTCDP information provided in accordance with the requirements of this paragraph should be as railroad independent as possible. This will allow the product’s PTCDP, and any associated Type Approval, to be shared by multiple railroads to the maximum extent possible. FRA believes that the PTCDP information provided in accordance with this provision will play an important role in FRA’s determination as to whether safety will be maximized and if regulatory compliance of the system is obtainable.

Paragraph (a)(2) requires a description of the operation where the product will be used. Upon receipt of this information within a PTCDP, FRA will have better contextual knowledge of the product as it applies to the type of operation on which it is designed to be used. Where operational behaviors are not applicable to a particular railroad, or the product design is not intended to address a particular operational behavior, FRA would expect a short statement indicating which operational characteristics do not apply and why they are not applicable.

Paragraph (a)(3) requires that the PTCDP include a concept of operations, a list of the product’s functional characteristics, and a description explaining how various components within the system are controlled. FRA expects that the information provided under paragraphs (a)(2) and (a)(3) will together provide a thorough understanding of the PTC system.

FRA will review this information—primarily by comparing the subject PTC system’s functionalities with those underlying principles contained in standards for existing signal and train control systems—to determine whether the PTC system is designed to account for all relevant safety issues. While FRA does not prescribe PTC system design standards, FRA will require that the applicant compare the concepts contained in existing standards to the operational concepts, functionalities, and controls contemplated for the PTC system in order to determine whether a sufficient level of safety will be achieved. For example, FRA requirements prescribe that where a track relay is de-energized, a switch or derail is improperly lined, a rail is removed, or a control circuit is opened, each signal governing movements into the subject block occupied by a train, locomotive, or car must display its most restrictive aspect for the safety of train operations. The principle behind the requirement is that, when a condition exists in the operating environment, or with respect to the functioning of the system, that entails a potential hazard, the system will assume its most restrictive state to protect the safety of train operations.

Paragraph (a)(4) requires that each PTCDP include a document that identifies and describes each safety critical function of the subject PTC system. The product architecture includes both hardware and software aspects which identify the protection developed against random hardware faults and systematic errors. Further, the document must identify the extent to which the architecture is fault tolerant. FRA intends to use this information to determine whether appropriate safety concepts have been incorporated into the proposed PTC system. For example, existing regulations require that when a route has been cleared for a train movement, it cannot be changed until the governing signal has been caused to display its most restrictive indication and a predetermined time interval has expired where time locking is used or where a train is in approach to the location where approach locking is used. FRA will apply this concept, among others, to determine whether all the safety-critical functions are included. Where such functionalities are not clearly determined to exist as a result of technology development, FRA will expect the reasoning to be stated and a justification provided describing how that technology provides the required level of safety. Where FRA identifies a void in safety-critical functions, FRA may not approve the PTCDP until remedial action is taken to rectify the concern.

FRA recognizes that the information required under paragraph (a)(4) may already be provided when complying with paragraph (a)(1). In such a case, the railroad shall cross reference where in the PTCDP that both paragraphs (a)(1) and (a)(4) are jointly satisfied.

Paragraph (a)(4) requires that each PTCDP address the minimum requirements under § 236.1005 for development of safety-critical PTC systems. FRA expects the information provided under paragraph (a)(5) to cover: identification of all safety requirements that govern the operation of a system; evaluation of the total system to identify known or potential safety hazards that may arise over the life cycle of the system; identification of all safety issues during the design phase of the process; elimination or reduction of the risk posed by the hazards identified; resolution of safety issues presented; development of a process to track progress; and development of a program of testing and analysis to demonstrate that safety requirements are met.

FRA has considered the railroad concerns, and agrees that the selection of the safety assurance concepts that any particular railroad may impose on their vendor might possibly differ, based on the railroad's operational philosophy and tolerance for risk. Accordingly, FRA removed former paragraph (a)(5) from the final rule as an element of the PTCDP, and has made the requirement to describe the safety assurance concepts an element of the PTCSP (see § 236.1015(d)(2)).

Paragraph (a)(5) requires a preliminary human factors analysis which must address each applicable human-machine interface (HMI) and all proposed product functions to be performed by humans to enhance or preserve safety. FRA expects this analysis to place special emphasis on proposed human factors responses—and the result of any failure to perform such a response—to safety-critical hazards including the consequences of human failure to perform. For each HMI, the

PTCDP should address the proposed basis of assumptions used for selecting each such interface, its potential affect upon safety, and all potential hazards associated with each interface. Where more than one employee is expected to perform duties dependent upon HMI input or output, the analysis must address the consequences of failure by one or multiple employees. FRA intends to use this information to determine the proposed HMI's effect upon the safety of railroad operations. The preliminary human factors analysis must propose how the railroad or its PTC system supplier plans to address the HMI criteria listed in Appendix E or any alternatives proposed by the railroad and deemed acceptable by the Associate Administrator. The design criteria for Appendix E were first developed and subsequently adopted by FRA as an element of subpart H of this part. As the criteria in Appendix E are generally technology neutral, FRA has adopted them with minor changes, for use with both subpart H of this part and these proceedings.

Paragraph (a)(5) also requires that the PTCDP explain how the proposed HMI will affect interoperability. RSIA08 requires that each subject railroad explain how it intends to obtain system interoperability. The ability of a train crew member to operate another railroad's PTC system significantly depends upon a commonly understood HMI. The HMI provides the end user with a method of interacting with the underlying system and accessing the PTC functionality. FRA expects that each railroad will adopt an HMI standard that will ensure ease of use of the PTC system both within, and between, railroads.

Paragraph (a)(6) requires an analysis regarding how subparts A through G of part 236 apply, or no longer apply, to the subject PTC system. FRA recognizes that while a PTC system may be designed in accordance with the underlying safety concepts of subparts A through G, the specific existing requirements contained in those subparts are not applicable. In any event, the PTCDP must identify each pertinent requirement considered to be inapplicable, fully describe the alternative method used to fulfill that underlying safety concept, and explain how the proposed PTC system supports the underlying safety principle. FRA notes that certain sections in subparts A though G may always be applicable to PTC systems certified under subpart I.

FRA is concerned about all dimensions of system security. Paragraph (a)(8) requires the PTCDP to include a description of the security measures necessary to meet the specifications for each product. Security is an important element in the design and development of products and covers issues such as developing measures to prevent hackers from gaining access to software and developing measures to preclude sudden system shutdown, mechanisms to provide message integrity, and means to authenticate the communicating parties.

Safety and security are two closely related topics. Both are conditions that, when met, the subject is protected and without risk of harm. In the industrial marketplace, the goals of safety and security are to create an environment protecting assets from hazards or harm. While activities to ensure safety usually relate to the possibility of accidental harm, activities to ensure security usually relate to protecting a subject from intentional malicious act such as espionage, theft, or attack. Since system performance may be affected by either inadvertent or deliberate hazards or harms, the safety and security involved in the implementation and operation of a PTC system must both be considered.

Integrated security recognizes that optimum protection comes from three mutually supporting elements: physical security measures, operational procedures and procedural security measures. Today the convergence of information and physical security is being driven by several powerful forces. These include interdependency, efficiency and organizational simplification, security awareness, regulations, directives, standards and the evolving global communications infrastructure. Physical security describes both measures that prevent or deter attackers from accessing a facility, resource, or information stored on physical media and guidance on how to design structures to resist various hostile acts. Communications security describes measures and controls taken to deny unauthorized persons information derived from telecommunications and ensure the authenticity of such telecommunications. Because of the integrated nature of security, FRA expects that the railroads discussion will also address security as a holistic concept, and not be restricted to limited or specific aspects.

Paragraph (a)(8) requires documentation of assumptions concerning reliability and availability targets of mechanical, electric, and electronic components. When building a PTC system, designers may make numerous assumptions that will directly impact specific implementation decisions. These fundamental assumptions usually come in the form of data (e.g., facts collected as the result of experience, observation or experiment, or processes, or premises) that can be randomly sampled. FRA does not expect to audit all of the fundamental assumptions on which a PTC system has been developed. Instead, FRA envisions sampling and reviewing fundamental assumptions prior to product implementation and after operation for some time. FRA expects that the data sampled may vary, depending upon the PTC system. It is not possible to provide a single set of quantitative numbers applicable to all systems, especially when systems have yet to be designed and for which the fundamental assumptions are yet to be determined.

Quantification is part of the risk management process for each project. FRA believes that the actual performance of the system observed during the pre-operational testing and post-implementation phases will provide indications of the validity of the fundamental assumptions. FRA provides that this review process will occur for the life of the PTC system (i.e., as long as the product is kept in operation). The depth of details required will depend upon what FRA observes. The range of difference between a PTC system’s predicted and actual performance may indicate to FRA the validity of the underlying fundamental assumptions. Generally, if the actual performance matches the predicted performance, FRA believes that it will not have to extensively review the fundamental assumptions. If the actual performance does not match predicted performance, FRA may need to more extensively review the fundamental assumptions.

FRA expects each subject railroad to confirm the validity of initial assumptions by comparing them to actual in-service data. FRA is aware that mechanical and electronic component failure rates and times to repair are easily quantified data, and usually are kept as part of the logistical tracking and maintenance management of a railroad. FRA believes that this criterion will enhance the quality of risk assessments conducted pursuant to this subpart by forcing PTC system designers and users to consider the long-term effects of operation over the course of the PTC system’s projected life-cycle. If a PTC system can be used beyond its design lifecycle, FRA expects that any continued use would be only under a waiver provided in accordance with part 211 or under a PTCDP amended in accordance with § 236.1021. In its request for waiver or request for amendment, the railroad should address any new risks associated with the life cycle extension.

Paragraph (a)(8) also requires specification of the target safety levels. This includes the identity of each potential hazard and how the events leading to a hazard will be identified for each safety-critical subsystems; the proposed safety integrity level of each safety-critical subsystem and the proposed way that accomplishment of these targets will be evaluated. This paragraph also requires identification of the proposed backup methods of operation and safety critical assumptions regarding availability of the product. FRA believes this information is essential for making determinations about the safety of a product and both the immediate and long-term effect of its failure. FRA contends that availability is directly related to safety to the extent the backup means of controlling operations involves greater risk (either inherently or because it is infrequently practiced).

Paragraph (a)(9) requires a complete description of how the PTC system will enforce all pertinent authorities and block signal, cab signal, or other signal related indications. FRA appreciates that not all PTC architectures will seek to enforce the speed restrictions associated with intermediate signals directly, but nevertheless a clear description of these functions is necessary for clarity and evaluation.

Paragraph (a)(10) requires that, if the railroad is seeking to deviate from the requirements of section 236.1029 with respect to movement of trains with onboard equipment that has failed en route using the flexibility provided by paragraph (c) of that section, a justification must be provided in the PTCDP. As proposed, paragraph (c) of § 236.1029 provided that, in order for a PTC train that operates at a speed above 90 miles per hour to deviate from the operating limitations contained in paragraph (b) of that section, the deviation must be described and justified in the FRA approved PTCDP or PTCSP, or by reference to an Order of Particular Applicability, as applicable.

For instance, if Amtrak wished to continue to operate at up to 125 miles per hour with cab signals and automatic train control in the case of failure of onboard ACSES equipment, Amtrak would request to do so based on the applicable language of the Order of Particular Applicability that required installation of that system on portions of the Northeast Corridor. Similarly, a railroad wishing more liberal requirements for a high speed rail system on a dedicated right-of-way could request that latitude by explaining how the safety of all affected train movements would be maintained. During the comment period and PTC Working Group discussion, Amtrak continued to press its case for greater flexibility, noting the long routes prevalent on its intercity network and the trip time penalty that could be incurred with failed equipment. Paragraph (a)(10) has been revised in the final rule to reflect the fact that the development plan would contain justification for any requested a deviation from the requirements of § 236.1029, and that section has been further revised to permit the agency to receive and consider specific requests and supporting information regarding latitude such as that sought by Amtrak without regard to speed. Instead, paragraph (a)(10) requires the railroad to include a justification in its PTCDP, if the railroad is seeking to deviate from the requirements of § 236.1029 with respect to movement of trains with onboard equipment that has failed en route.

Paragraph (a)(11) requires a complete description of how the PTC system will appropriately and timely enforce all hazard detectors that are interconnected with the PTC system in accordance with § 236.1005(c)(3), as may be applicable.

Paragraph (b) specifies the approval standard that will be employed by the Associate Administrator. APTA asserted that the NPRM offered minimal guidance on what criteria FRA will use in accepting or rejecting a system. Thus, APTA suggested that FRA should draft and vet criteria that accomplishes the basic purposes of PTC while allowing for innovation in meeting the performance requirements envisioned in the regulation. The PTCDP is not expected to provide absolute assurance to the Associate Administrator for Safety. It only needs to establish it meets the appropriate statutory and regulatory requirements for a PTC system required under this subpart, and that there is a reasonable chance that once built, it will meet the required safety standards for its intended use. FRA emphasizes that approval of a PTCDP and issuance of a type approval does not constitute final approval to operate the product in revenue service. Such approval only comes after the Associate Administrator for Safety approves the PTCSP, and issues a PTC System Certification.

Paragraph (c) establishes a time limit on the validity of a Type Approval. Provided that at least one product is certified within the 5 year period after issuance of the Type Approval, the Type Approval remains valid until final retirement of the system. The main purpose of this requirement is to incentivize installation, not just creation, of a PTC system. This paragraph would also allow FRA to periodically clean out its records relating to Type Approvals and PTCDPs for obsolete PTC systems.

Former paragraphs (d) and (e) in this section have been moved to § 236.1015 in the final rule. Therefore, former paragraph (f) has been redesignated as paragraph (d) in the final rule.

Paragraph (d) discusses the Associate Administrator's ability to impose any conditions necessary to ensure the safety of the public, train crews, and train operations when approving the PTCDP and issuing a Type Approval. While FRA expects that adherence to the remainder of this section's requirements should justify issuance of a Type Approval, FRA also recognizes that there may be situations where other unaccounted for variables may reduce the Associate Administrator's confidence in the PTC system, its manufacturer, supplier, vendor, or operator.

The required contents of the NPI are specified in paragraph (e). As stated earlier, FRA expects submission of an NPI in lieu of a PTCDP only when the railroad is unable to obtain all of the information required for a PTCDP. This will enable railroads to submit a PTCIP on or before the statutory deadline of April 16, 2010. FRA believes, given the various options available to the railroads, that there are few, if any, valid reasons for not meeting the April 16, 2010 deadline for submission.

The elements that make up the NPI were carefully chosen to strike a balance between the ability of a railroad that is unable to complete a full PTCDP and FRA's need to fully understand the railroad's proposed product and the reasonableness of the PTCIP contents. FRA believes that the NPI information is information that would be required to have been identified by the railroad in order to develop requests for proposal from the vendor community. Paragraph (e)(i) requires a description of the proposed operating environment. Paragraph (e)(ii) requires a description of the concept of operations for any PTC product that will be procured by the railroad. Paragraph (e)(iii) requires a description of the target safety levels that the railroad expects the product to meet, while paragraphs (e)(iv) and (e)(v) require an explanation of how the proposed product will integrate with the existing signal and train control system.

The costs and benefits associated with Type approval are included in the general analysis below. Type approval is a cost minimizing alternative for meeting the PTCDP requirement.

4.15 Section 236.1015, PTCSP Content Requirements and PTC System Certification

The PTCSP is the core document which provides the Associate Administrator for Safety the information necessary to certify the as-built PTC system fulfills the required statutory PTC functions and is in compliance with the requirements of this s Issuance of a System Certification is contingent upon the approval of the PTCSP by the Associate Administrator for Safety. Under the final rule, the filing and approval of the PTCSP and issuance of a PTC System Certification is a mandatory prerequisite for PTC system operation in revenue service. Each PTCSP is unique to each railroad and must addresses railroad-specific implementation issues associated with the PTC system identified by the submitted Type Approval. Paragraph (a) codifies these meanings and limits.

Paragraph (b), which reflects the contents of proposed paragraphs (d) and (e) in proposed § 236.1013, establishes the conditions under which a Type Approval may be used by another railroad. Paragraph (b)(1) requires the railroad to maintain a continually updated PTC Product Vendor List (PTCPVL) pursuant to § 236.1023 to enable the railroad and FRA to determine the appropriate vendor to contact in the unlikely event of a safety critical failure.

The safety critical nature of PTC systems imposes strict quality control requirements on the design and manufacturer of the system. While FRA believes that in the vast majority of cases, the vendor or supplier community from whom the railroads will procure PTC system components have established the appropriate quality control systems, there will be a very small minority who have not. Paragraph (b)(2) is intended to mitigate against any such occurrence, to ensure that PTC system components meet the same, uniformly high, standards. FRA is requiring that the railroad ensure that any vendor from whom they purchase PTC system or components has an acceptable quality assurance program for both design and manufacturing processes.

FRA has considered comments submitted by GE, in which GE suggested language to further clarify paragraph (b)(2) that the vendor quality control processes for PTC systems must include the process for the product supplier to promptly report any safety relevant failure and previously unidentified hazards to each railroad using the product. FRA believes that this suggested language clearly specifies the importance of this requirement to suppliers who may not already have the appropriate quality control processes in place. Accordingly, FRA has added the recommended language.

Paragraph (b)(3) requires the railroad to provide licensing information. The list should include all applicable vendors or suppliers. Through the requirements set forth in paragraph (b)(3), FRA intends to ensure implementation of the proper technology, as opposed to implementation of an orphan product that uses similar, yet different, technology. When a railroad submits a previously approved Type Approval for its PTC system, FRA expects that all the proper licensing agreements will provide for continued use and maintenance of the PTC system in place. To bolster FRA's confidence in this area, FRA will require each Type Approval submission to include the relevant licensing information. FRA recognizes that there may be various licensing arrangements available relating to the exclusivity and sublicensing of manufacturing or vending of a particular PTC system. There may be other intellectual property variables that may make arrangements even more complex. To adequately capture all applicable arrangements, FRA is requiring the submission of "licensing information." A more specific request may preclude FRA's ability to collect information necessary to fulfill its intent. If any of this information were to change, either through any type of sale, transfer, or sublicense of any right or ownership, then FRA would expect the railroad to submit a request for amendment of its PTCDP in accordance with § 236.1021. FRA recognizes that this may be difficult for a railroad to accomplish, given the fact that the railroad may not be privy to any intellectual property transactions that may occur outside its control. In any event, FRA would expect that a railroad will ensure, either through contractual obligation or otherwise, that its vendor or supplier will provide it with updated licensing information on a continuing basis.

When filing a PTCSP, paragraph (c) requires each railroad to include the applicable and approved PTCDP or, if applicable, the FRA issued Type Approval. In addition, the railroad must describe any changes subsequently made to the PTC system that would require amendment of the PTCDP or assure FRA that the PTC system built is the same PTC system described in the PTCDP and PTCSP. Some elements of the PTCSP are the same elements as the PTCDP (and are described more fully in the section-by-section analysis of § 236.1013). If the railroad has already submitted, and FRA has already approved, the PTCDP, then attachment of the PTCDP to the PTCSP should fulfill this requirement.

FRA recognizes the possibility that between PTCIP or PTCDP approval, and prior to PTCSP submission, there may be changes to the former two documents. While such changes may only be made in accordance with § 236.1021, documentation of those changes may not be readily apparent to the reader of the PTCSP. Further, changes in the PTCIP may impact the contents of the PTCDP and vice versa. Accordingly, paragraph (c)(1) requires the railroad to submit the approved PTCDP (or Type Approval) with the corresponding PTCSP.

AAR asserted that the main purpose of the PTCIP is to document the deployment plan and that the PTCIP will be of little value once the implementation is complete. Accordingly, AAR asserts that there is no need to include the PTCIP when filing either a PTCDP or PTCSP. The AAR also asserted that since the PTCSP justifies that the PTC system was built in accordance with the PTCDP, submission of the PTCIP information should not be required.

FRA agrees with AAR that the main purpose of the PTCIP is to document the deployment plan and that the PTCIP will essentially become a historical document when the railroad has completed its PTC implementation. Therefore, until all PTC system installations have been completed, FRA will require the PTCIP to be kept current with the railroad's deployment plan. However, in response to the AAR's comments, FRA has revised paragraph (c) by removing the proposed requirement to submit the PTCIP with the PTCDP and PTCSP.

FRA expects that each PTCSP shall include a clear and complete description of any such changes by specifically and rigorously documenting each variance. Paragraph (c)(2) also requires that the PTCSP include an explanation of each variance's significance. To ensure that there are no other existing variances not documented in the PTCSP, the railroad must attest that there are no further variances. For the same reason, paragraph (c)(3) requires that, if there have been no changes to the plans or to the PTC system as intended, the railroad must attest that there are no such variances.

The additional required railroad specific elements are as follows:

Paragraph (d)(1) requires that the PTCSP include a hazard log comprehensively describing all hazards to be addressed during the life-cycle of the product, including maximum threshold limits for each hazard. For unidentified hazards, the threshold shall be exceeded at one occurrence. In other words, if the hazard has not been predicted, then any single occurrence of that hazard is unacceptable. The hazard log addresses safety-relevant hazards, or incidents or failures that affect the safety and risk assumptions of the PTC system. Safety relevant hazards include events such as false proceed signal indications and false restrictive signal indications. If false restrictive signal indications occur with any type of frequency, they could influence train crew members, roadway workers, dispatchers, or other users to develop an apathetic attitude towards complying with signal indications or instructions from the PTC system, creating human factors problems.

Incidents in which stop indications are inappropriately displayed may also necessitate sudden brake applications that may involve risk of derailment due to in-train forces. Other unsafe or wrong-side failures that affect the safety of the product will be recorded on the hazard log. The intent of this paragraph is to identify all possible safety-relevant hazards that would have a negative effect on the safety of the product. Right-side failures, or product failures that have no adverse effect on the safety of the product (i.e., do not result in a hazard) would not be required to be recorded on the hazard log.

Paragraph (d)(2), which has been added to the final rule, requires that each railroad identify the PTC system's safety assurance concepts. When identifying the safety assurance concepts used, FRA expects the information provided pursuant to paragraph (d)(2) will reflect the safety requirements that govern the operation of a system; the identify of known or potential safety hazards that may arise over the life-cycle of the system; safety issues that may arise during the design phase of the process; elimination or reduction of the risks posed by the hazards identified; resolution of safety issues presented; development of a process to track progress; and development of a program of testing and analysis to demonstrate that safety requirements are being met.

In the proposed rule, this information was required as part of the PTCDP. One railroad recommended that this information requirement be completely eliminated as redundant because it is covered as part of the product safety requirements. FRA agrees that this information should not be a required element of the PTCDP; this information should be provided as an element of the railroad specific PTCSP, since individual railroads may elect to require different safety assurance concepts from their vendors or suppliers. This very same information is an integral element of the railroad specific Product Safety Plan required by subpart H of this part. Accordingly, FRA has revised this requirement. However, FRA does not believe that this information is redundant. The safety assurance concepts imposed on the vendor or supplier are procedural requirements that drive vendor or supplier system design and mitigation strategies. FRA believes that the importance of the safety assurance concepts merits clear identification.

Paragraph (d)(3) requires that a risk assessment be included in the PTCSP. FRA will use this information as a basis to confirm compliance with the appropriate performance standard. A performance standard specifies the outcome required, but leaves the specific measures to achieve that outcome up to the discretion of the regulated entity. In contrast to a design standard or a technology-based standard that specifies exactly how to achieve compliance, a performance standard sets a goal and lets each regulated entity decide how to meet that goal. An appropriate performance standard should provide reasonable assurance of safe and effective performance by making provision for: (1) considering the construction, components, ingredients, and properties of the device and its compatibility with other systems and connections to such systems; (2) testing of the product on a sample basis or, if necessary, on an individual basis; (3) measurement of the performance characteristics; and (4) requiring that the results of each or of certain of the tests required show that the device is in conformity with the portions of the standard for which the test or tests were required. Typically, the specific process used to design, verify and validate the product is specified in a private or public standard. The Associate Administrator may recognize all or part of an appropriate standard established by a nationally or internationally recognized standard development organization.
RLO expressed concern during this rulemaking regarding FRA's position on the treatment of wrong side failures. Wrong side failures, which occur when a PTC system fails to properly identify the track occupied by a train, should not be considered an acceptable risk. Such failures, which are completely avoidable using current technology, can result in unnecessary and risky penalty brake applications.

FRA agrees that wrong side failures introduce an element of risk in the operation of a system. Therefore, the extent of that risk and the consequences of the failure must be identified and carefully analyzed. It is for that very reason that FRA is requiring that the hazard log identify all such potential failures. The hazard mitigation analysis required in paragraph (d)(4) must identify how each hazard in the hazard log will be mitigated. While FRA agrees the majority of wrong side failures can be eliminated through the application of technology, FRA believes that the generalization that all wrong side failures can be eliminated is not valid.

Paragraph (d)(4) requires that the PTCSP include a hazard mitigation analysis. The hazard mitigation analysis must identify the techniques used to investigate the consequences of various hazards and list all hazards addressed in the system hardware and software including failure mode, possible cause, effect of failure, and remedial actions. A safety-critical system must satisfy certain specific safety requirements specified by the system designer or procuring entity. To determine whether these requirements are satisfied, the safety assessor must determine that: (1) hazards associated with the system have been comprehensively identified; (2) hazards have been appropriately categorized according to risk (likelihood and severity); (3) appropriate techniques for mitigating the hazards have been identified; and (4) hazard mitigation techniques have been effectively applied. See Leveson, Nancy G., Safeware: System Safety and Computers, (Addison-Wesley Publishing Company, 1995).

FRA does not expect that the safety assessment will prove that a product is absolutely safe. However, the safety assessment should provide evidence that risks associated with the product have been carefully considered and that steps have been taken to eliminate or mitigate them. Hazards associated with product use need to be identified, with particular focus on those hazards found to have significant safety effects. The risk assessment provided under paragraph (d)(4) must include each hazard that cannot be mitigated by system designs (e.g., human over-reliance of the automated systems) no matter how low its probability may be. After the risk assessment, the designer must take steps to remove them or mitigate their effects. Hazard analysis methods are employed to identify, eliminate, and mitigate hazards. Under certain circumstances, FRA may require an independent third party assessment in accordance with proposed § 236.1017 to review these methods as a prerequisite to FRA approval.

Paragraph (d)(5) also requires that the PTCSP address safety Verification and Validation procedures as defined under part 236. FRA believes that Verification and Validation for safety are vital parts of the PTC system development process. Verification and Validation require forward planning. Consequently, the PTCSP should identify the testing to be performed at each stage of development and the levels of rigor applied during the testing process. FRA will use this information to ensure that the adequacy and coverage of the tests are appropriate.

Paragraph (d)(6) requires the railroad to include in its PTCSP the training, qualification, and designation program for workers regardless of whether those railroad employees will perform inspection, testing, and maintenance tasks involving the PTC system. FRA believes many benefits accrue from the investment in comprehensive training programs and are fundamental to creating a safe workforce. Effective training programs can result in fewer instances of human casualties and defective equipment, leading to increased operating efficiencies, less troubleshooting, and decreased costs. FRA expects any training program will include employees, supervisors, and contractors engaged in railroad operations, installation, repair, modification, testing, or maintenance of equipment and structures associated with the product.

Paragraph (d)(7) requires the railroad to identify specific procedures and test equipment necessary to ensure the safe operation, installation, repair, modification and testing of the product in its PTCSP. Requirements for operation of the system must be succinct in every respect. The procedures must be specific about the methodology to be employed for each test to be performed that is required for installation, repair, or modification and the results thereof must be documented. FRA will review and compare the repair and test procedures for adequacy against existing similar requirements prescribed for signal and train control systems. FRA intends to use this information to ascertain whether the product will be properly installed, maintained, tested, and repaired.

Paragraph (d)(8) requires that each railroad develop a manual covering the requirements for the installation, periodic maintenance and testing, modification, and repair for its PTC system. The railroad's Operations and Maintenance Manual must address the issuance of warnings and describe the warning labels to be placed on each piece of PTC system equipment as necessary. Such warnings include, but are not limited to: means to prevent unauthorized access to the system; warnings of electrical shock hazards; cautionary notices about improper usage, testing, or operation; and configuration management of memory and databases. The PTCSP should provide an explanation justifying each such warning and an explanation of why there are no alternatives that would mitigate or eliminate the hazard for which the warning will be given.

Paragraph (d)(9) requires that the PTCSP identify the various configurable applications of the product, since this rule mandates use of the product only in the manner described in its PTCDP. Given the importance of proper configuration management in safety-critical systems, FRA believes it is essential that railroads learn of and take appropriate configuration control of hardware and software. FRA believes that a requirement for configuration management control will enhance the safety of these systems and ultimately provide other benefits to the railroad as well. Pursuant to this paragraph, railroads will be responsible—through its applicable Operations and Maintenance Plan and other supporting documentation maintained throughout the system's life-cycle—for all changes to configuration of their products in use, including both changes resulting from maintenance and engineering control changes, which result from manufacturer modifications to the product. Since not all railroads may experience the same software faults or hardware failures, the configuration management and fault reporting tracking system play a crucial role in the ability of the railroad and the FRA to determine and fully understand the risks and their implications. Without an effective configuration management tracking system in place, it is difficult, if not impossible, to fairly evaluate risks associated with a product over its life-cycle.

Paragraph (d)(10) requires the railroad to develop comprehensive plans and procedures for product implementation. Implementation (field validation or cutover) procedures must be prepared in detail and identify the processes necessary to verify that the PTC system is properly installed and documented, including measures to provide for the safety of train operations during installation. FRA will use this information to ascertain whether the product will be properly installed, maintained, and tested. FRA also believes that configuration management should reduce disarrangement issues. Further, configuration management will reduce the cost of troubleshooting by reducing the number of variables and will be more effective in promoting safety.

Paragraph (d)(11) requires the railroad to provide a complete description of the particulars concerning measures required to assure that the PTC system, once implemented, continues to provide the expected safety level without degradation or variation over its life-cycle. The measures specifically provide the prescribed intervals and criteria for the following: testing; scheduled preventive maintenance requirements; procedures for configuration management; and procedures for modifications, repair, replacement and adjustment of equipment. FRA intends to use this information, among other data, to monitor the PTC system to assure it continually functions as intended.

Paragraph (d)(12) requires that each PTCSP include a description of each record concerning safe operation. Recordkeeping requirements for each product are discussed in § 236.1037 of this part.

Paragraph (d)(13) requires a safety analysis of unintended incursions into a work zone. Measuring incursion risks is a key safety risk assumption. Failing to identify incursion risk can have the effect of making a system seem safer on paper than it actually is. The requirements set forth in this paragraph attempt to mandate design consideration of incursion protection at an early stage in the product development process. The totality of the arrangements made to prevent unintended incursions or operation at higher than authorized speed within the work zone must be analyzed. That is, in addition to the functions of the PTC system, the required actions for dispatchers, train crews, and roadway workers in charge must be evaluated. Regardless of whether a PTC system has been previously approved or recognized, FRA will not accept a system that allows a single point human failure to defeat the essential protection intended by the Congress. See NTSB Recommendations R-08-05 and R-08-06. FRA believes that exposure should be identified because increases in risk due to increased exposure could be easily distinguished from increases in risk due solely to implementation and use of the proposed PTC system.

In the past, little attention was given to formalizing incursion protection procedures. Training for crews has also not been uniform among organizations, and has frequently received inadequate attention. As a result, a variety of procedures and techniques evolved based on what has been observed or what just seemed correct at the time. This lack of structure, standardization, and formal training is inconsistent with the goal of increasing the safety and regulatory efficiency.

As proposed, paragraph (d)(14) would have required a more detailed description of any alternative arrangements provided under § 236.1011(a)(10), pertaining to at grade rail-to-rail crossings. APTA noted that the reference in this paragraph should be revised, as section 236.1011(a)(10) does not exist. The correct reference is § 236.1005(a)(1)(i).

Paragraph (d)(15) requires a complete description of how the PTC system will enforce mandatory directives and signal indications, unless already addressed in the PTCDP. Paragraph (d)(16) refers to the requirement of § 236.1019(f) that the PTCSP is aligned with the PTCIP, including any amendments.

As previously mentioned, § 236.1005(a) requires each applicable PTC system to be designed to prevent train-to-train collisions. Under that section, FRA has established various requirements that would apply to at-grade rail-to-rail crossings, also known as diamond crossings. While the final rule text includes certain specific technical requirements, it also provides the opportunity for each subject railroad to submit an alternative arrangement providing an equivalent level of safety as specified in an FRA approved PTCSP. Accordingly, under paragraph (d)(14), if the railroad intends to utilize alternative arrangements providing an equivalent level of safety to that of the table provided under § 236.1005(a)(1)(i), each PTCSP must identify those alternative arrangements and methods, with any associated risk reduction measures, in its PTCSP.

Under § 236.1007, FRA requires certain limitations on PTC trains operating over 90 miles per hour, including compliance with § 236.1029(c). Under § 236.1029(c), FRA provides railroads with an opportunity to deviate from those limitations if the railroad describes and justifies the deviation in its PTCDP, PTCSP, or by reference to an Order of Particular Applicability, as applicable. Thus, paragraph (d)(17) reminds railroads that this is one of the optional elements that may be included in a PTCSP. This need may also be addressed through review of the PTCDP.

Railroads are required under § 236.1005(c) to submit a complete description of its compliance regarding hazard detector integration and under §§ 236.1005(g)-(k) to submit a temporary rerouting plan in the event of emergencies and planned maintenance. Railroads must also submit a document indicating any alternative arrangements for each rail at-grade crossing not adhering to the table under § 236.1005(a)(1)(i).

Paragraphs (d)(18), (d)(19), and (d)(20) remind railroads that such requirements must be fulfilled with the submission of the PTCSP. For example, under paragraph (d)(19), FRA expects each temporary rerouting plan to explain the host railroad's procedure relating to detouring the applicable traffic. In other words, FRA expects that each temporary rerouting plan address how the host railroad will choose the track that traffic will be rerouted onto. For instance, the plan should explain the factors that will be considered in determining whether and how the railroad should take advantage of temporary rerouting. FRA remains concerned about the unnecessary commingling of PTC and non-PTC traffic on the same track and expects each temporary rerouting plan to address this possibility. More specifically, each plan should describe how the railroad expects to make decisions to reroute non-PTC train traffic onto a PTC line, especially where another non-PTC line may be available. While FRA recognizes each railroad may seek to use the most cost effective route, FRA expects the railroad to also consider the level of risk associated with that route.

In paragraph (e), FRA states the criteria to which FRA will refer when evaluating the PTCSP, depending upon the underlying technical approach. Whereas in subpart H of this part, the safety case is evaluated to determine whether it demonstrates with a high degree of confidence that relevant risk will be no greater under the new product than previously, the statutory mandate for PTC calls for a different approach. In crafting this approach, FRA has attempted to limit requirements for quantitative risk assessment to those situations where the technique is truly needed. Regardless of the type of PTC system, the safety case for the system must demonstrate that it will reliably execute all of the functions required by this subpart (particularly those provided under §§ 236.1005 and 236.1007). With this foundation, the additional criteria that must be met depend upon the type of PTC technology to be employed.

It is FRA's understanding that PTC systems may be categorized as one of the following four system types: non-vital overlay; vital overlay; standalone; and mixed. Initially, however, all PTC systems will have some features that are not fully fail-safe in nature, even if onboard processing and certain wayside functions are fully fail-safe. Common causes include surveying errors of the track database, errors in consist weight or makeup from the railroad information technology systems, and the crew input errors of critical operational data. To the extent computer-aided dispatching systems are the only check on potential dispatcher error in the creation or inappropriate cancellation of mandatory directives, some room for undetected wrong-side failure will continue to exist in this function as well.

Paragraph (e)(1) specifies the required behavior for non-vital overlay systems. Based on previous experience with non-vital systems, FRA believes it is well within the technical capability of the railroads to reduce the level of risk on any particular track segment to a level of risk 80% lower than the level of risk prior to installation of PTC on that segment. For subsequent PTC system installations on the same track segment FRA recognizes that requiring an additional 80% improvement may not be technically or economically practical. Therefore, FRA is only requiring that an entity installing or a modifying an existing PTC system demonstrate that the level of safety is equal to, and preferably greater than, the level of safety of the prior PTC system. The risk that must be reduced is the risk against which the PTC functionalities are directed, assuming a high level of availability. Note that the required functionalities themselves do not call for elimination of all risk of mishaps. It is scope of risk reduction that the functionalities describe that becomes the 100% universe which is the basis of comparison. Although it is understood that the system will endeavor to eliminate 100% of this risk—meaning that if the system worked as intended every time and was always available, 100% of the target risk would be eliminated—the analysts will need to account for cases where wrong side failure of the technology is coincident with a human failure potentially induced by reliance on the technology. Since, within an appropriate conservative engineering analysis (i.e., pro forma analysis), non-vital processing has the theoretical potential to result in more failures than will typically be experienced, a 20% margin is provided. In preparing the PTCSP, the railroad should affirmatively address how training and oversight—including programs of operational testing under 49 CFR § 217.9—will reduce the potential for inappropriate reliance by those charged with functioning in accordance with the underlying method of operation.

The 80% reduction in risk for PTC preventable accidents must be demonstrated by an appropriate risk analysis acceptable to the Associate Administrator and must address all intended track segments upon which the system will be installed. Again, FRA does not expect, or require, that these types of systems will prevent all wrong side failures. However, FRA expects that the systems will be designed to be robust, all pertinent risk factors (including human factors) will be fully addressed, and that no corners will be cut to "take advantage" of the nominal allowance provided for non-vital approaches. FRA also encourages those using non-vital approaches to preserve as much as possible the potential for a transition to vital processing.

The Rail Labor Organizations believe that FRA's position is inconsistent with safety. Wrong side failures occur when a PTC system fails to properly identify the track occupied by a train. According to the RLO, such failures, which are completely avoidable using current technology, can result in unnecessary penalty braking applications that risk causing train handling derailments due to in-train forces and may also cause a PTC system to fail to enforce a necessary stop. As such, the RLO believe that wrong side failures should not be considered an acceptable risk. Again, FRA is sympathetic in principle to the RLO concern. However, signal or train control system is wholly without the potential for a wrong side failure; and the key to limiting their occurrence is identifying the potential and crafting mitigations where possible. Built on the foundation of existing methods of operation, PTC systems will drastically reduce unsafe events by providing a safety net for occasional human errors. It would be unwise to defer the promise of PTC by demanding perfection and thereby permit accidents and casualties to continue.

Paragraph (e)(2) addresses vital overlays. Unlike a non-vital system, the vital system must be designed to address, at a minimum, the factors delineated in Appendix C. The railroad and their vendors are encouraged to carry out a more thorough design analysis addressing any other potential product specific hazards. FRA cannot overemphasize that vital overlay system designs must be fully designed to address the factors contained in Appendix C. The associated risk analysis supporting this design analysis demonstrating compliance may be accomplished using any of the risk analysis approaches in subpart H, including abbreviated risk analysis.

Paragraph (e)(3) addresses stand-alone PTC systems that are used to replace existing methods of operations. The PTCSP design and risk analysis submitted to the Associate Administrator must show that the system does not introduce any new hazards that have not been acceptably mitigated, based upon all proposed changes in railroad operation. GE proffered the suggestion that when the standalone system is created using proven principles of vital signaling, assessing the system risk is straightforward and not significantly different than with the vital overlay system. The importance of system availability and risk under operations in contingent mode become more significant factors. FRA agrees, but believes that the one of the fundamental issues that the agency must reconcile is the value of appropriately capturing these principles in new systems and with new technologies without artificially restricting their use. FRA must accordingly exercise great care when evaluating the safety cases presented to it, regardless of the type (overlay, standalone, or mixed).

While FRA believes that a comprehensive safety analysis will be required for all systems, since it must provide sufficient information to the Associate Administrator to make a decision with a high degree of confidence, the required analysis for standalone systems is much more comprehensive than that required for vital overlay systems because it must provide sufficient information to the Associate Administrator to make a decision with a high degree of confidence. FRA will therefore exercise greater oversight when it uniquely and separately considers each request for standalone operations, and will render decisions in the context of the proposed operation and the associated risks. FRA recognizes that application of this standard to a new rail system for which there is no clear North American antecedent could present a conceptual challenge.

Paragraph (e)(4) addresses mixed systems (i.e., systems that include a combination of the systems identified in paragraphs (e)(1) through (e)(3). Because of the inherent complexity of these systems, FRA will determine an appropriate approach for demonstrating compliance after consultation with the railroad. Any approach will of course, require that the system perform the PTC requirements set forth in §§ 236.1005 and 236.1007.

Paragraph (f) discusses the factors that the Associate Administrator will consider in reviewing the PTCSP. In general, PTC systems will have some features that are not fail-safe in nature. Examples include surveys of the track database, errors in consist data from the railroad such as weight and makeup, and crew input errors. FRA participation in the design and testing of the PTC system product helps FRA to better understand the strengths and weaknesses of the product for which approval is requested, and facilitates the approval process.

The railroad must establish through safety analysis that its assertions are true. This standard places the burden on the railroad to demonstrate that the safety analysis is accurate and sufficiently supports certification of the PTC system. The FRA Associate Administrator will determine whether the railroad's case has been made. As provided in subpart H, FRA believes that final agency determinations under this new subpart I should also be made at the technical level, rather than the policy level, due to the complex and sometimes esoteric subject matters associated with risk analysis and evaluation. This is particularly appropriate in light of the RSIA08's designation of the Associate Administrator for Railroad Safety as the Chief Safety Officer of FRA. When considering the PTC system's compliance with recognized standards in product development, FRA will weigh appropriate factors, including: the use of recognized standards in system design and safety analyses; the acceptable methods in risk estimates; the proven safety records for proposed components; and the overall complexity and novelty of the product design. In those cases where the submission lacks information the Associate Administrator deems necessary to make an informed safety decision, FRA will solicit the data from the railroad. If the railroad does not provide the requested information, FRA may determine that a safety hazard exists. Depending upon the amount and scope of the missing data, PTCSP approval, and the subsequent system certification, may be denied.

APTA asserts that the NPRM offers minimal guidance on what criteria FRA will use in accepting or rejecting a system. Thus, APTA suggested that FRA should draft and vet criteria that accomplishes the basic purposes of PTC while allowing for innovation in meeting the performance requirements envisioned in the regulation.

While paragraph (f) summarizes how FRA intends to evaluate the risk analysis, paragraph (g) applies specifically to cases where a PTC system has already been installed and the railroad subsequently wants to put in a new PTC system. Paragraph (g) re-emphasizes that FRA policy regarding the safety of PTC systems is not, and cannot expect to be, static. Rather, FRA policy may evolve as railroad operations evolve, operating rules are refined, related hazards are addressed (e.g., broken rails), and other readily available options for risk reduction emerge and become more affordable. FRA embraces the concept of progressive improvement and expects that when new systems are installed to replace existing systems that actual safety outcomes equal or exceed those for the existing systems.

Finally, paragraph (h) emphasizes the need for the PTCSP to carefully document ALL potential sources of error that can be introduced into the system and their corresponding mitigation strategies. FRA reserves the right to require quantitative, as opposed to qualitative risk assessments, especially in cases where there is significant residual risk or changes to the method of operations.

The costs and benefits associated with this section are included in the general analysis below.

4.16 Section 236.1017, Independent Third Party Review of Verification and Validation

As previously noted in § 236.1009(e), FRA may require a railroad to engage in an independent assessment of its PTC system. In the event an independent assessment is required, § 236.1017 provides the applicable rules and procedures.

Paragraph (a) establishes factors considered by FRA when requiring a third-party assessment. FRA will attempt to make a determination of what level of third party assessment is necessary as early in the approval process as possible. However based on issues that may arise during the development and testing processes, or during the detailed technical reviews of the PTCDP and PTCSP, FRA may deem it necessary to require a third party assessment after the initial determination was made.

Paragraph (b) is intended to make it clear that it is FRA who will make the determination of the acceptability of the independence of the third party. If a third party assessment is required, railroads are encouraged to identify in writing who they propose to utilize as their third party. This is intended to avoid any potential issues downstream regarding the acceptability of the independence of the assessor. Compliance with paragraph (b) is not mandatory. However, the railroad must understand that if FRA determines that the railroads choice of a third party does not meet the independence requires of paragraph (c), then the railroad will be obligated to have the assessment repeated, at their expense, until it has been completed by a third party suitable to FRA.

Paragraph (c) defines the term ``independent third party'' as used in this section. It limits independent third parties to ones ``compensated by' the railroad or an association on behalf of one or more railroads that is independent of the supplier of the product. FRA believes that requiring the railroad to compensate a third party will heighten the railroad's interest in obtaining a quality analysis and will avoid ambiguous supplier/third-party relationships that could indicate possible conflicts of interest.

Paragraph (d) explains that the minimum requirements of a third party audit are outlined in Appendix D and that FRA has discretion to the limit the extent of the third party assessment. As the criteria in Appendix D are, for the most part, technology neutral, FRA has adopted them with minor changes, for use with both Subpart H of this part and these proceedings. FRA intends to limits the scope of the assessment to areas of the safety validation and verification as much as possible, with in the bounds of FRA's regulatory obligations. This will allow reviewers to focus on areas of greatest safety concern and eliminate any unnecessary expense to the railroad. In order to limit the number of third-party assessments, FRA first strives to inform the railroad as to what portions of a submittal could be amended to avoid the necessity and expense of a third-party assessment altogether. However FRA wishes to make it clear that Appendix D represents minimum requirements, and that if circumstances warrant, FRA may expand upon the Appendix D requirements as necessary to enable FRA to render a decision that is in the public interest (i.e., if FRA is unable to certify the system without the additional information).

The costs and benefits of this section are included in the general analysis below.

4.17 Section 236.1019, Main Line Track Exceptions

The RSIA08 generally defines "main line" as "a segment of railroad tracks over which 5,000,000 or more gross tons of railroad traffic is transported annually. See 49 U.S.C. § 20157(i)(2). However, FRA may also define "main line" by regulation "for intercity rail passenger transportation or commuter rail passenger transportation routes or segments over which limited or no freight railroad operations occur." See 49 U.S.C. § 20157(i)(2)(B); 49 CFR 1.49(oo). FRA recognizes that there may be circumstances where certain statutory PTC system implementation and operation requirements are not practical and provide no significant safety benefits. In those circumstances, FRA will exercise its statutory discretion provided under 49 U.S.C. § 20157(i)(2)(B).

In accordance with the authority provided by the statute and with carefully considered recommendations from the RSAC, FRA will consider requests for designation of track over which rail operations are conducted as "other than main line track" for passenger and commuter railroads, or freight railroads operating jointly with passenger or commuter railroads. Such relief may be granted only after request by the railroad or railroads filing a PTCIP and approval by the Associate Administrator.

Paragraph (a), therefore, requires the submittal of a main line track exclusion addendum (MTEA) to any PTCIP filed by a railroad that seeks to have any particular track segment deemed as other than main line. Since the statute only provides for such regulatory flexibility as it applies to passenger transportation routes or segments which limited or no freight railroad operations occur, only a passenger railroad may file an MTEA as part of its PTCIP. This may include a PTCIP jointly filed by freight and passenger railroads. In fact, FRA expects that in the case of joint operations, only one MTEA should be agreed upon and submitted by the railroads filing the PTCIP. After reviewing a submitted MTEA, FRA may provide full or conditional approval for the requested exemptions.

Each MTEA must clearly identify and define the physical boundaries, use, and characterization of the trackage for which exclusion is requested. When describing each track's use and characterization, FRA expects the requesting railroad or railroads to include copies of the applicable track and signal charts. Ultimately, FRA expects each MTEA to include information sufficiently specific to enable easy segregation between main line track and non-main line track. In the event the railroad subsequently requests additional track to be considered for exclusion, a well-defined MTEA should reduce the amount of future information required to be submitted to FRA. Moreover, if FRA decides to grant only certain requests in an MTEA, the portions of track for which FRA has determined should remain considered as main line track can be easily severed from the MTEA. Otherwise, the entire MTEA, and thus its concomitant PTCIP, may be entirely disapproved by FRA, increasing the risk of the railroad or railroads not meeting its statutory deadline for PTC implementation and operation.

For each particular track segment, the MTEA must also provide a justification for such designation in accordance with paragraphs (b) or (c) of this section.

Paragraph (b) specifically addresses the conditions for relief for passenger and commuter railroads with respect to passenger-only terminal areas. As noted previously in the analysis of § 236.1005(b), any track within a yard used exclusively by freight operations moving at restricted speed is excepted from the definition of main line. In those situations, operations are usually limited to preparing trains for transportation and do not usually include actual transportation. This automatic exclusion does not extend to yard or terminal tracks that include passenger operations.

Such operations may also include the boarding and disembarking of passengers, heightening FRA's sensitivity to safety. Moreover, while FRA could not expend its resources to review whether a freight-only yard should be deemed other than main line track, FRA believes that the relatively lower number of passenger yards and terminals would allow for such review. Accordingly, FRA believes that it is appropriate to review these circumstances on a case-by-case basis.

During the PTC Working Group discussions, the major passenger railroads requested an exception for tracks in passenger terminal areas because of the impracticability of installing PTC. These are locations were signal systems govern movements over very complex special track work divided into short signal blocks. Operating speeds are low (not to exceed 20 miles per hour), and locomotive engineers moving in this environment expect conflicting traffic and restrictive signals.

Although low-speed collisions do occasionally occur in these environments, the consequences are low; and the rate of occurrence is very low in relation to the exposure. It is the nature of current-generation PTC systems that they use conservative braking algorithms. Requiring PTC to short blocks in congested terminals would add to congestion and frustrate efficient passenger service, in the judgment of those who operate these railroads. The density of wayside infrastructure required to effect PTC functions in these terminal areas would also be exceptionally costly in relation to the benefits obtained. FRA agrees that technical solutions to address these concerns are not presently available. FRA does believe that the appropriate role for PTC in this context is to enforce the maximum allowable speed (which is presently accomplished in cab signal territory through use of automatic speed control, a practice which could continue where already in place).

If FRA grants relief, the conditions of paragraphs (b)(1), (b)(2), or (b)(3), as applicable, as well as conditions attached to the approval, must be strictly adhered to.

Under paragraph (b)(1), relief under paragraph (b) is limited to operations that do not exceed 20 miles per hour. The PTC Working Group agreed upon the 20 miles per hour limitation, instead of requiring restricted speed, because the operations in question will be by signal indication in congested and complex terminals with short block lengths and numerous turnouts. FRA agrees with the PTC Working Group that the use of restricted speed in this environment would exacerbate congestion, delay trains, and diminish the quality of rail passenger service.

Moreover, when trains on the excluded track are controlled by a locomotive with an operative PTC onboard apparatus that PTC system component must enforce the regulatory speed limit or actual maximum authorized speed, whichever is less. While the actual track may not be outfitted with a PTC system in light of a MTEA approval, FRA believes it is nevertheless prudent to require such enforcement when the technology is available on the operating locomotives. This can be accomplished in cab signal territory using existing automatic train stop technology and outside of cab signal territory by mapping the terminal and causing the onboard computer to enforce the maximum speed allowed.

FRA also limits relief under paragraph (b)(2) to operations that enforce interlocking rules. Under interlocking rules, trains are prohibited from moving in reverse directions without dispatcher permission on track where there are no signal indications. FRA believes that such a restriction will minimize the potential for a head-on impact.

Also, under paragraph (b)(3), such operations are only allowed in yard or terminal areas where no freight operations are permitted. While the definition of main line may not include yard tracks used solely by freight operations, FRA is not extending any relief or exception to tracks within yards or terminals shared by freight and passenger operations. The collision of a passenger train with a freight consist is typically a more severe condition because of the greater mass of the freight equipment. However, FRA did receive a comment suggesting some latitude within terminals when passenger trains are moving without passengers (e.g., to access repair and servicing areas). FRA agrees that low-speed operations under those conditions should be acceptable as trains are prepared for transportation. FRA has not included a request by Amtrak (discussed below) to allow movements within major terminals at up to 30 miles per hour in mixed passenger and freight service, which appears in FRA's judgment to fall outside of the authority to provide exclusions conferred on FRA by the law.

Paragraph (c) provides the conditions under which joint limited passenger and freight operations may occur on defined track segments without the requirement for installation of PTC. Under § 236.1003 (Definitions), "limited operations" is defined as "operations on main line track that have limited or no freight operations and are approved to be excepted from this subpart's PTC system implementation and operation requirements in accordance with § 236.1019(c) This paragraph provides five alternative paths to the main line exception, three of which were contained in the proposed rule and a fourth and fifth that respond to comments on the proposed rule.

The three alternatives derived from the NPRM are set forth in paragraph (c)(1). First, an exception may be available where both the freight and passenger trains are limited to restricted speed. Such operations are feasible only for short distances, and FRA will examine the circumstances involved to ensure that the exposure is limited and that appropriate operating rules and training are in place.

Second, under paragraph (c)(1)(ii), FRA will consider an exception where temporal separation of the freight and passenger operations can be ensured. A more complete definition of temporal separation is provided in paragraph (e). Temporal separation of passenger and freight services reduces risk because the likelihood of a collision is reduced (e.g., due to freight cars engaged in switching that are not properly secured) and the possibility of a relatively more severe collision between a passenger train and much heavier freight consist is obviated.

Third, under paragraph (c)(1)(iii), FRA will consider commingled freight and passenger operations provided that a jointly agreed risk analysis is provided by the passenger and freight railroads, and the level of safety is the same as that which would be provided under one of the two prior options selected as the base case. FRA requested comments on whether FRA or the subject railroad should determine the appropriate base case, but received none. FRA recognizes that there may be situations where temporal separation may not be possible. In such situations, FRA may allow commingled operations provided the risk to the passenger operation is no greater than if the passenger and freight trains were operating under temporal separation or with all trains limited to restricted speed. For an exception to be made under paragraph (c)(3), FRA requires a risk analysis jointly agreed to and submitted by the applicable freight and passenger services. This ensures that the risks and consequences to both parties have been fully analyzed, understood, and mitigated to the extent practical. FRA would expect that the moving party would elect a base case offering the greatest clarity and justify the selection.

Comments on the proposed rule generally supported the aforementioned exclusions or were silent.

In its comments on the NPRM, Amtrak requested further relief relating to lines requiring the implementation and operation of a PTC system due solely to the presence of light-density passenger traffic. According to Amtrak, the defining characteristic of light-density lines is the nature of the train traffic; low-density patterns on these lines lead to a correspondingly low risk of collision. Amtrak also asserted that, due to relatively limited wear and tear from lower traffic densities, these lines often have fewer track workers on site, further reducing the chance of collisions and incursions into work zones. Thus, states Amtrak, one of the principal reasons for installing PTC—collision avoidance—is a relatively low risk on many light density lines. With only marginal safety benefits anticipated from PTC use in such applications, Amtrak believed that there may be minimal justification for installing PTC on certain light-density lines.

Amtrak further noted that FRA itself had concluded that the costs of PTC generally exceed its benefits, and Amtrak urged that this may be even more so on light-density lines. Amtrak believed that Congress understood this issue and thus created the regulatory flexibility for the definition of "main line" for passenger routes found at 49 U.S.C § 20157(i)(2)(B) as a means to allow the Secretary to exempt certain routes from the PTC mandate. According to Amtrak, this provision essentially allows the Secretary to define certain passenger routes with limited or no freight traffic as other than "main line," thereby effectively exempting such lines from the reach of the PTC mandate because the mandate only applies to railroad operations over "main line[s]." Said another way, urged Amtrak, the provision allows the Secretary the freedom to decide in what circumstances such routes should be considered "main lines" and thus be required to install PTC–pursuant to whatever factors the Secretary deems appropriate through the rulemaking process.

Amtrak urged that the Secretary should use this flexibility to limit which passenger routes it defines as "main lines" to those deemed to warrant the use of PTC using the FRA's usual risk-based approach to safety regulation and traditional measures of reasonableness, costs, and benefits. Amtrak posited that such a risk-based analysis by FRA would likely lead to the conclusion that PTC is simply not needed on many light-density lines over which passenger trains currently operate. Amtrak therefore asked that FRA exercise this authority by working with Amtrak and the rail industry to exempt certain light density freight lines which host passenger traffic from the obligation to install PTC where operating and safety conditions do not warrant an advanced signal system.

Should FRA choose not to exempt some of these light density freight lines over which passenger trains operate, Amtrak felt that the high costs of full PTC systems will be passed on to the passenger and freight operators of these routes. According to Amtrak, this obligation could threaten the continuation of intercity passenger rail service on several routes, including lines in

California, Colorado, Kansas, Maine, Massachusetts, Michigan, Missouri, New Hampshire, New Mexico, North Dakota, Vermont, and Virginia, on what are potentially light density lines. Additionally, states Amtrak, this obligation, where it can be financed, could force the diversion of significant capital dollars away from essential safety investments in track and other infrastructure improvements, which are typically the leading safety risks for such light-density operations. According to Amtrak, the cost of PTC installation on these lines may be so out of proportion to the benefit that Amtrak's service will need to be rerouted onto a different line (e.g., to a Class I line with PIH) if a reroute option exists, or eliminated entirely because there is no feasible alternate route and no party is willing or able to bear the cost of installing PTC on the existing route. The defining characteristic of light-density lines is the nature of the train traffic: low density patterns on these lines lead to a correspondingly low risk of collision. In its filing, Amtrak noted that it was currently assembling the details (e.g., annual freight tonnage, frequency of freight train operations) "for those lines that it believes may qualify as light-density, and will submit as a supplement to these Comments a recommendation as to what criteria the FRA should adopt in determining what light-density lines are other than 'main lines.'" Amtrak did subsequently file data referred to below, but did not propose criteria.

According to the Amtrak testimony, the "limited operations exception" in subsection 236.1019(c) of the NPRM did not provide a practical solution to the problem created by defining all light-density routes and terminal areas with passenger service as "main lines." Amtrak stated that this subsection would arguably require installation of PTC on most of the trackage and locomotives of the Terminal Railroad Association of St Louis (TRRA) unless: 1) the entire terminal operates at restricted speed (which TRRA is unlikely to agree to), 2) passenger and freight trains are temporally separated (which would not be practical on TRRA, and is unlikely to be practical on any of the light-density lines over which Amtrak operates, due to the 24/7 nature of railroad operations), or 3) a risk mitigation plan can be effected that would achieve a level of safety not less than would pertain if all operations on TRRA were at restricted speed or subject to temporal separation. Accordingly, Amtrak recommended: (a) that the FRA adopt a risk analysis-based definition of "main line" passenger routes that excludes light-density lines on which the installation of PTC is not warranted; and (b) with respect to freight terminal areas in which passenger trains operate, that the FRA modify the limited operations exception in subsection 236.1019(c) to require that all trains be limited to 30 miles per hour rather than to restricted speed, or that non-PTC equipped freight terminals be deemed as other than "main lines" so long as all passenger operations are pursuant to signal indication and at speeds not greater than 30 miles per hour (with speeds reduced to not greater than restricted speed on unsignaled trackage or if the signals should fail).

FRA believes that Amtrak's request is much broader than contemplated by the law. FRA notes that TRRA is a very busy terminal operation. FRA does not believe that the "limited freight operations" concept is in any way applicable under those circumstances. Nor is there any indication in law that FRA was expected to fall back to traditional cost-benefit principles in relation to PTC and scheduled passenger service. However, there are a number of Amtrak routes with limited freight operations that will not otherwise be equipped with PTC because they are operated by other than Class I railroads. Further, there are some Class I lines with less than 5 mgt, or no PIH, that also warrant individualized review to the extent Amtrak and the host railroad might elect to propose it.

Accordingly, in response to the Amtrak comments, paragraph (c)(2) and (c)(3) have been added to the final rule to provide an option by which certain additional types of limited passenger train operations may qualify for a main line track exception where freight operations are also suitably limited and the circumstances could lead to significant hardship and cost that might overwhelm the value of the passenger service provided.

Paragraph (c)(2) deals with lines where the host is not a Class I freight railroad, describing characteristics of line segments are might warrant relief from PTC. Paragraph (c)(2)(i) pertains to passenger service involving up to four regularly scheduled passenger trains during a calendar day over a segment of unsignaled track on which less than 15 million gross tons of freight traffic is transported annually. Paragraph (c)(2)(ii) pertains to passenger service involving up to 12 regularly scheduled passenger trains during a calendar day over a segment of signaled track on which less than 15 million gross tons of freight traffic is transported annually. Paragraph (c)(2) derived indirectly from discussions in the RSAC in response to comments by Amtrak set forth above. The PTC Working Group proposed an exception that might have been available anywhere an intercity or commuter railroad operated over a line with 5 million gross tons of freight traffic, including Class I lines and the lines of the intercity or commuter railroad. This would have opened the potential for a considerable exception for lines with very light freight density under circumstances not thoroughly explored in the short time available to the working group (e.g., on commuter rail branch lines, low density track segments on Class I railroads, etc.).

Subsequent to the RSAC activities, Amtrak notified FRA that its conversations with Class II and III railroads whose lines at been at the root of the Amtrak comments revealed that some of the situations involved freight traffic exceeding 5 mgt, potentially rendering the exception ineffective for this purpose. At the same time, FRA noted that the policy rationale behind the proposed additional exception was related as much to the inherent difficulty associated with PTC installation during the initial period defined by law, given that the railroads identified by Amtrak were for the most part very small operations with limited technical capacity, as we as limited safety exposure. It was clear that in these cases care would need to be taken to analyze collision risk and potentially require mitigations.[10]

Accordingly, FRA has endeavored to address the concern brought forward by Amtrak with a provision that is broad enough to permit consideration of actual circumstances, limit this particular exception to operations over railroads that would not otherwise need to install PTC (e.g., Class II and III freight railroads), provide for a thorough review process, and make explicit reference to the potential requirement for safety mitigations. In this regard, FRA has chosen 15 million gross tons as a threshold that should accommodate situations where Amtrak trains will, in actuality, face few conflicts with freight movements (i.e., requiring trains to clear the main line for meets and passes or to wait at junctions) and where mitigations are in place or could be put in place to establish a

[10] An example of an existing mitigation, which is provided to support service quality but also supports safety, is the practice of one Class III Amtrak host and its connecting freight partner to hold out fleeted empty coal trains off the Class III property during the period that Amtrak is running. While not constituting strict “temporal separation,” it does significantly reduce collision risk over the route.

high sense of confidence that operations will continue to be conducted safely. FRA believes that less than 15 mgt represents a fair test of "limited freight operations" for these purposes, with the further caveat that specific operating arrangements will be examined in each case. FRA emphasizes that this is not an entitlement, but an exclusion for which the affected railroads will need to make a suitable case.

Amtrak also provided to FRA a spreadsheet identifying each of its route segments with attributes such as route length, freight tonnage, number of Amtrak trains, and numbers of commuter trains. FRA further reviewed this information in light of Amtrak's request for main track exceptions. FRA noted a number of segments of the Amtrak system on Class I railroads where the number of Amtrak trains was low and the freight tonnage was also low (<15 mgt). Each of these lines, with the exception of one 33-mile segment, is signalized. FRA further noted that, with both Amtrak and Class I railroad locomotives equipped for PTC, use of partial PTC technology (e.g., monitoring of switches where trains frequently clear) should be available as a mitigation for collision risk. Accordingly, in paragraph (c)(3) FRA has provided a further narrow exception for Class I lines carrying no more than four intercity or commuter passenger trains per day and cumulative annual tonnage of less than 15 mgt, subject to FRA review. The limit of four trains takes into consideration that it is much less burdensome to equip the wayside of a Class I rail line than to install a full PTC system on a railroad that would not otherwise require one. Again, the exception is not automatic, and FRA's approval of a particular line segment would be discretionary. Any Class I line carrying both 5 mgt and PIH traffic would, of course, not be eligible for consideration.[11]

The new paragraph (d) makes clear that FRA will carefully review each proposed main track exception and may require that it be supported by appropriate hazard analysis and mitigations. FRA has previously vetted through the RSAC a Collision Hazard Analysis Guide that can be useful for this purpose. If FRA determines that freight operations are not "limited" as a matter of safety exposure or that proposed safety mitigations are inadequate, FRA will deny the exception.

Paragraph (e) (formerly paragraph (d) in the proposed rule) provides the definition of temporal separation with respect to paragraph (c)(2). The temporal separation approach is currently used under the FRA-Federal Transit Administration Joint Policy on Shared Use, which permits co-existence of light rail passenger services (during the day) and local freight service (during the nighttime). See Joint Statement of Agency Policy Concerning Shared Use of the Tracks of the General Railroad System by Conventional Railroads and Light Rail Transit Systems, 65 FR. 42,526 (July 10, 2000); FRA Statement of Agency Policy Concerning Jurisdiction Over the Safety of Railroad Passenger Operations and Waivers Related to Shared Use of the Tracks of the General Railroad System by Light Rail and Conventional Equipment, 65 FR 42,529 (July 10, 2000).

Conventional rail technology and secure procedures are used to ensure that these services do not

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[11] An example of an existing mitigation, which is provided to support service quality but also supports safety, is the practice of one Class III Amtrak host and its connecting freight partner to hold out fleeted empty coal trains off the Class III property during the period that Amtrak is running. While not constituting strict "temporal separation," it does significantly reduce collision risk over the route.

commingle. Amtrak representatives in the PTC Working Group were confident that more refined temporal separation strategies could be employed on smaller railroads that carry light freight volumes and few Amtrak trains (e.g., one train per day or one train per day in each direction). The Passenger Task Force agreed. The UTA also supported the temporal separation exception under former paragraph (d), having stated that temporal separation is important in the operations of many commuter and intercity passenger railroad carriers.

Paragraph (f) (paragraph (e) in the proposed rule) ensures that by the time the railroad submits its PTCSP, no unapproved changes have been made to the MTEA and that the PTC system, as implemented, reflects the PTCIP and its MTEA. Under this final rule, the PTCSP must reflect the PTCIP, including its MTEA, as it was approved or how it has been modified in accordance with § 236.1021. FRA believes that it is also important that the railroad attest that no other changes to the documents or to the PTC system, as implemented, have been made.

FRA understands that as a railroad implements its PTC system in accordance with its PTCIP or even after it receives PTC System Certification, the railroad may decide to modify the scope of which tracks it believes to be other than main line. To effectuate such changes, paragraph (g) requires FRA review. In the case that the railroad believes that such relief is warranted, the railroad may file in accordance with § 236.1021 a request for amendment of the PTCIP, which will eventually be incorporated into the PTCSP upon PTCSP submission. Each request, however, must be fully justified to and approved by the Associate Administrator before the requested change can be made to the PTCIP. If such a RFA is submitted simultaneously with the PTCSP, the RFA may not be approved, even if the PTCSP is otherwise acceptable. A change made to a MTEA subsequent to FRA approval of its associated PTCIP that involves removal or reduction in functionality of the PTC system will be treated as a material modification. In keeping with traditional signaling principles, such requests must be formally submitted for review and approval by FRA.

The costs and benefits of this section are included in the general analysis below. The flexibility granted here is a key part of complying with the Regulatory Flexibility Act, and is discussed in the regulatory flexibility analysis below.

4.18 Section 236.1021, Discontinuances, Material Modifications, and Amendments

FRA recognizes that after submittal of a plan or implementation of a train control system, the subject railroad may have legitimate reasons for making changes in the system design and the locations where the system is installed. In light of the statutory and regulatory mandates, however, FRA believes that the railroad should be required to request FRA approval prior to effectuating certain changes. Section 236.1021 provides the scope and procedure for requesting and approving those changes. For example, all requests for covered changes must be made in a request for amendment (RFA) of the subject PTC system or plan. While § 236.1021 includes lengthy descriptions of what changes may, or may not, require FRA approval, there are various places elsewhere in subpart I that also require the filing of a RFA.

Paragraph (a) requires FRA approval prior to certain PTC system changes. FRA expects that if a railroad wants to make a PTC system change covered by subpart I, then any such change would result in noncompliance with one of the railroad's plans approved under this subpart. For instance, if a railroad seeks to modify the geographical limits of its PTC implementation, such changes would not be reflected in the PTCIP. Accordingly, under paragraph (a), after a plan is approved by FRA and before any change is made to the PTC system's development, implementation, or operation, the railroad must file a RFA to the subject plan.

FRA considers an amendment to be a formal or official change made to the PTC system or its associated PTCIP, PTCDP, or PTCSP. Amendments can add, remove, or update parts of these documents, which may reflect proposed changes to the development, implementation, or operation of its PTC system. FRA believes that an amending procedure provides a simpler and cleaner option than requiring the railroad to file an entirely new plan.

While the railroad may develop a RFA without FRA input or involvement, FRA believes that it is more advantageous for the railroad to informally confer with FRA before formally submitting its RFA. If FRA is not involved in the drafting process, FRA may not have a complete understanding of the system, making it difficult for FRA to evaluate the impact of the proposed changes on public safety. After RFA submission, all applicable correspondence between FRA and the railroad must be made formally in the associated docket, as further discussed below. In such a situation, FRA's review may take a significantly longer time than usual. If FRA continues to not understand the impact, it may request a third party audit, which would only further delay a decision on the request. Accordingly, FRA believes it is more advantageous for the railroad drafting an RFA to informally confer with FRA before its formal submission of the change request. The railroad would then be provided an opportunity to discuss the details of the change and to assure FRA's understanding of what the railroad wishes to change and of the change's potential impact.

Paragraph (b) provides the mechanism for requesting such change. Once the RFA is approved, the railroad may—and, in fact, is required under paragraph (b)—to adopt those changes into the subject plan and immediately ensure that its PTC complies with the plan, as amended. FRA expects that each PTC system accurately reflects the information in its associated approved plans. FRA believes that this requirement will also incentivize railroads to make approved changes as quickly as possible. Otherwise, if a railroad delays in implementing the changes reflected in an approved RFA, FRA may find it difficult to enforce its regulations until implementation is completed, since they plans and PTC system to not accurately and adequately reflect each other. In such circumstances, railroads may be assessed a civil penalty for violating its plan or for falsifying records.

Any change to a PTCIP, PTCDP, or PTCSP, which may include removal or discontinuance of any signal system, may not take effect until after FRA has approved the corresponding submitted or amended PTCIP, PTCDP, or PTCSP. FRA may provide partial or conditional approval. Until FRA has granted appropriate relief or approval, the railroad may not make the change, and once a requested change has been made, the railroad must comply with requested change.

FRA recognizes that a railroad may wish to remove an existing train control system due to new and appropriate PTC system implementation. For train control systems existing prior to promulgation of subpart I, any request for a material modification or discontinuance must be made pursuant to part 235. Paragraph (c), however, provides the railroads with an opportunity to instead request such changes in accordance with § 236.1021. FRA believes that this requirement will reduce the number of required filings and would otherwise simplify the process requesting material modifications or discontinuances.

Paragraph (d) provides the minimum information required to be submitted to FRA when requesting an amendment. While the procedural rules here are different than those in part 235, FRA expects that the same or similar information be provided. Accordingly, under paragraph (d)(1), the RFA must contain the information required in 235.10. Paragraph (d)(1) also requires the railroad to submit, upon FRA request, certain additional information, including the information referenced in § 235.12. Paragraphs (d)(2) through (d)(7) provide further examples of such information. While such information may only be required upon request, FRA urges each railroad to include this information in its RFA to help expedite the review process.

FRA believes that paragraphs (d)(2) through (d)(6) are self-explanatory. However, according to paragraph (d)(7), FRA may require with each RFA an explanation of whether each change to the PTCSP is planned or unplanned. Planned changes are those that the system developer and the railroad have included in the safety analysis associated with the PTC system, but have not yet implemented. These changes provide enhanced functionality to the system, and FRA strongly encourages railroads to include PTC system improvements that further increase safety. A planned change may require FRA approved regression testing to demonstrate that its implementation has not had an adverse affect on the system it is augmenting. Each planned change must be clearly identified as part of the PTCSP, and the PTCSP safety analysis must show the affect that its implementation will have on safety.

Unplanned changes are those either not foreseen by the railroad or developer, but nevertheless necessary to ensure system safety, or are unplanned functional enhancements from the original core system. The scope of any additional necessary work necessary to ensure safety may depend upon when in the development cycle phase the changes are introduced. For instance, if the PTCDP has not yet been submitted to FRA, no FRA involvement is required. However if the PTCDP has been submitted to FRA, or if the change impacts the safety functionality of the system once a Type Approval has been issued, and a PTCSP has not yet submitted, the railroad must submit a RFA requesting and documenting that change. Once FRA approves that RFA, FRA expects the subsequently filed PTCSP to account for the change in analysis.

If the change is made after approval of the PTCSP and the system has been certified by FRA, a RFA must be submitted to FRA for approval. Because this requires significant effort by FRA and the railroad, FRA expects that every effort will be made to eliminate the need for unplanned changes. If the railroad and the vendor submit unplanned safety related changes that FRA believes are a significant amount or inordinately complex, FRA may revoke any approvals previously granted and disallow the use of the product until such time the railroad demonstrates the product is sufficiently mature.

Paragraph (e) provides that if a RFA is submitted for a discontinuance or a material modification to a portion or all of its PTC system, a notice of its submission shall be published in the Federal Register. Interested parties will be provided an opportunity to comment on the RFA, which will be located in an identified docket.

Paragraph (f) makes it clear that FRA will consider all impacts on public safety prior to approval or disapproval of any request for discontinuance, modification, or amendment of a PTC system and any associated changes in the existing signal system that may have been concurrently submitted. While the economic impact to the affected parties may be considered by the FRA, the primary and final deciding factor on any FRA decision is safety. FRA will consider not only how safety is affected by installation of the system, but how safety is impacted by the failure modes of the system.

SCRRA submitted comments requesting “easy streamlined approval” of incremental changes and additions to the plans based on procurement and type approval of vendor products. However, FRA would like to point out that, where lines change during or subsequent to the railroad’s submission of its PTCIP, the railroad merely needs to identify its plan for implementation on such lines in its RFA. This does not appear to be an overly burdensome task.

The purpose of paragraph (g) is to emphasize the right of FRA to unilaterally issue a new Type Approval, with whatever conditions are necessary to ensure safety based on the impact of the proposed changes.

In paragraph (h), FRA makes clear that it considers any implemented PTC system to be a safety device. Accordingly, the discontinuance, modification, or other change of the implemented system or its geographical limits will not be authorized without prior FRA approval. While this requirement primarily applies to safety critical changes, FRA believes that they should also apply to all changes that will affect interoperability. The principles expressed in the paragraph parallel those embodied in part 235, which implements 49 U.S.C. § 20502(a).

That said, FRA recognizes that there are a limited number of situations where changes of the PTC system may not have an adverse impact upon public safety. Specific situations where prior FRA approval is required are provided in paragraphs (h)(1) through (h)(4).

Paragraph (i) provides the exceptions from the requirement for prior approval in cases where the discontinuance of a system or system element will be treated as pre-approved, as when a line of railroad is abandoned.

Paragraph (j) provides exceptions for certain lesser changes that are not expected to materially affect system risk, such as removal of an electric lock from a switch where speed is low and trains are not allowed to clear.

The AAR submitted comment that paragraphs (j)(2) and (j)(3) should be revised to recognize the allowance for removal of a signal used in lieu of an electric or mechanical lock in the same manner as removal of the electric or mechanical lock. These two paragraphs are intended to recognize that where train speed over the switch does not exceed 20 miles per hour, or where trains are not

permitted to clear the main track at the switch, removal of the devices intended to provide the necessary protection should not require the submission of a filing for FRA approval.
The regulation requiring the installation of an electric or mechanical lock identifies the allowance for a signal used in lieu thereof (see § 236.410). FRA agrees with the AAR that when the requirement for an electric or mechanical lock, or a signal used in lieu thereof, are eliminated, the removal of any of these devices in their entirety without filing for approval is appropriate. FRA has therefore revised paragraphs (j)(2) and (j)(3) to clarify these allowances.

Paragraph (k) provides additional exceptions consisting of modifications associated with changes in the track structure or temporary construction. FRA notes that only temporary removal of the PTC system without prior FRA approval is allowed to support highway rail separation construction or damage to the PTC system by catastrophic events. In both cases, the PTC system must be restored to operation no later than 6 months after completion of the event.

Caltrain submitted comments stating that paragraph (k)(6) and § 236.1009(a)(2)(ii)(B) appear to address the installation of new track in an inconsistent manner. While paragraph (k)(6) states that it will not be necessary to file a Request for Amendment for the installation of new track, § 236.1009(a)(2)(ii)(B) states that an RFA must be filed if railroad intends to add, subtract, or otherwise materially modify one or more lines of railroad for which installation of a PTC system is required.

FRA agrees that there appears to have been a conflict between the provisions contained in paragraph (k)(6) and § 236.1009(a)(2)(ii)(B). In light of the fact that FRA considers it necessary to file an RFA if the railroad intends to install new track for which installation of a PTC system is required, FRA has deleted paragraph former paragraph (k)(6) from the final rule. Along the same vein, FRA has also deleted former paragraph (k)(5) from the final rule, as FRA considers it necessary to file an RFA for line relocation projects.

This provision does not add any new costs or benefits, as it reflects current burdens for discontinuance or modification of existing signal systems.

4.19 Section 236.1023, Errors and Malfunctions

For purposes of this section, an error can be defined as a difference between the desired and actual performance or behavior of a system or object. A malfunction occurs when something functions wrongly, or does not function at all. In either case, errors and malfunctions are indications that assumptions made by the system engineers are flawed. As part of the normal design process, system engineers make assumptions regarding the expected failure modes and frequencies of the constituent components as well as the PTC system as whole. Often it is only after the product has been placed in field service for an extended period of time before the accuracy of the assumptions can be validated. Accordingly, the reporting and recording of errors and malfunctions takes on critical importance. If the number of errors and malfunctions exceeds those originally anticipated in the design, or errors and malfunctions that were not predicted are observed to occur, the accuracy of the engineering design analysis becomes suspect. The requirements of this section provide the mechanism for tracking, reporting, and correction of errors and malfunctions, and the processes and procedures for addressing these issues. While the final rule reflects all of the requirements presented in this section of the NPRM, it has been reorganized for greater clarity.

Paragraph (a) of this section contains the requirement for all railroads operating a PTC system to establish and maintain a Positive Train Control Product Vendor List (PTCPVL). The PTCPVL list ensures that the railroad can quickly determine the vendor of the product that has experienced an error or malfunctioned, and then be able to report the occurrence of the error or malfunction in a timely and accurate manner to the appropriate entity responsible for the design and manufacture of the product. Because of the interactions between the design, manufacture, and subsequent implementation of PTC products, and the processes used to operate and maintain them, FRA requires information about each to be recorded. The requirement for FRA access to the PTCPVL enables FRA to quickly identify all railroads that may potentially be affected by the condition, allowing FRA to better understand the implications of the condition. Not all railroads using the same product or processes may experience the same software errors or hardware failures, even if the cause of the error or failure is systemic to the design, and an individual railroad may not have the resources to determine if there are any industry-wide implications. The general requirements of this section were originally proposed in paragraph (c) of the NPRM.

Paragraph (b)(1) establishes a requirement that the railroad specify in its PTCSP all contractual arrangements with their vendors or suppliers for immediate notification of safety-critical upgrades made to the product by the vendors or suppliers. FRA is not interested in the commercial terms of any such contractual arrangement, only that the contractual arrangement is in place for notification and provision of safety-critical changes from a vendor or supplier to the railroad. Paragraph (b)(2) levies the requirement on the vendor or supplier to report to all railroads using the product any safety-critical failures reported. Paragraph (b)(3) levies a requirement on the vendor or supplier to provide accurate and adequate information of the circumstances surrounding the reported failure to any potentially affected railroad, as well as recommended mitigating actions that should be taken until the situation is resolved. The text of paragraph (b) has been modified slightly from that of the NPRM to more accurately reflect FRA's expectation in this regard.

Paragraph (c)(1) levies the requirement on the railroad to specify in its PTCSP the process and procedures the railroad will implement when a safety-critical upgrade or failure notification is received from the vendor or supplier. This requirement is necessary regardless of whether the railroad itself discovers the problem or the vendor or supplier notifies the railroad of the problem. Paragraph (c)(2) requires the railroads to identify the associated configuration management process they will use to identify safety-critical failures and mitigations. FRA believes it to be essential, given the potential impact on safety of a safety-critical failure, that the railroads have the necessary planning and mechanisms in place to promptly address the situation. Each railroad's and vendor's or supplier's development processes, configuration management programs, and fault reporting tracking systems play a crucial role in the ability of both parties and the FRA to determine and fully understand the risks and implications. Without an effective configuration management tracking system in place, it is difficult, if not impossible, to fairly evaluate PTC system risks during the system's life-cycle.

Paragraph (d) requires that the railroad provide to its vendor or supplier the railroad's processes and procedures for addressing safety-critical failure, malfunction, and fault issues. FRA believes that by providing this information to the vendor or supplier, the vendor or supplier will be able to more efficiently and effectively provide notification to the appropriate railroad personnel. The net result FRA is seeking is that potential delays in identifying or correcting safety-critical faults will be minimized.

Paragraph (e) requires the railroad to maintain a database of all safety-relevant hazards identified in its PTCSP, as well as all safety-relevant hazards that were not previously identified. FRA believes that the requirement to report any safety-relevant hazard that was not previously identified in the PTCSP is self evident, in that it clearly represents an unknown and unplanned failure mode. Without this database, a railroad will be unable to determine if the number of particular failures has risen to a level above the thresholds set forth in the PTCSP. If the frequency of the safety-relevant hazards exceeds the thresholds set forth in the PTCSP, the railroads shall take the following specific actions as prescribed in this section: notify the applicable vendor or supplier and the FRA; keep the applicable vendor or supplier and the FRA apprised of the status of any and all subsequent failures; and, take prompt countermeasures to eliminate or reduce the frequency below the threshold identified. Until the corrective action is complete, the railroad is required to take measures to ensure the safety of train operations, roadway workers, on track equipment, and the general public.

While the preceding paragraphs dealt with the establishment of a framework to address errors and malfunctions, paragraphs (f) through (g) deal with the actual handling and reporting of errors and malfunctions within that framework. Paragraph (f) establishes time limits for reporting failures and malfunctions to the product vendor or supplier and the FRA as well as minimum reporting requirements. The period for notification has been lengthened from that proposed in the NPRM to 15 days. FRA wishes to emphasize that it is more interested in timely notifications, and accordingly, has not established a specific format for the reports. FRA will accept any report format, provided it contains at least the minimal information required by this section. FRA will accept delivery of these reports by commercial courier, fax, and e-mail. However, with respect to information that is not immediately available, paragraph (f) has been amended to require railroads to submit supplemental reports with the previously unavailable information. FRA requires this information to determine the full impact of the problem, and to determine if any additional restrictions or limitations on the use of the PTC system may be warranted to ensure the safety of the general public and the railroad personnel. If the correcting or mitigating action were to take a significant amount of time, FRA would expect the railroad to provide FRA with periodic frequent progress reports.

Paragraph (g) establishes a reporting requirement for railroads and vendors or suppliers to provide to the Associate Administrator on request the results of any investigation of an accident or service difficulty report that shows the PTC system, subsystem, or component is unsafe because of a manufacturing or design defect. In addition, the railroad and its vendor or supplier may be required to report on any action taken or proposed to correct the defect.

Paragraph (h) imposes a direct obligation on suppliers to report safety-relevant failures or defective conditions, previously unidentified hazards, and recommended mitigation actions in their

PTC system, subsystem, or component to each railroad using its product. Each applicable supplier is also required to notify FRA of the safety-relevant failure, defective condition, or previously unidentified hazard discovered by the vendor or supplier and the identity of each affected and notified railroad. FRA believes that it should be informed to ensure public safety in any case where a commercial dispute (e.g., over liability) might disrupt communication between a railroad and supplier.

GE submitted a comment on this section, in which it raised an objection to the direct imposition by FRA of a reporting obligation on PTC suppliers. GE believes this requirement is unwarranted for three reasons. First, the railroad is the primary entity having knowledge of such a failure and already has the obligation to report a failure within strict guidelines. Second, even if the PTC supplier becomes aware of a failure, the PTC supplier may not have sufficient understanding of the failure to determine whether it is truly safety-related in nature without talking to the railroad. Third, there already exist sufficient legal incentives for a supplier to quickly resolve any safety-related failure that might occur. GE believes that railroads' regulatory compliance responsibilities should not be delegated to suppliers. Ultimately, GE asserts that this requirement unnecessarily complicates the task of deploying PTC and is unwarranted.

GE proposed alternative language at the RSAC PTC Working Group meeting held August 31-September 2, 2009, that removed the supplier's obligation to directly report to FRA by deleting proposed paragraphs (a) and (f) of this section and adding language to § 236.1015(b)(2). In this proposed alternative language, GE recommended that FRA require suppliers to include a process for promptly reporting any safety relevant failure and previously unidentified hazard to each railroad using the product in the quality control systems maintained by suppliers for PTC system design and manufacturing.

FRA carefully considered GE's recommendation. In § 236.907(d), FRA has previously established for PTC systems that are voluntarily implemented by railroads, under the provisions of subpart H of this part, a requirement that the vendor/supplier and railroads establish mutual reporting relationships for promptly reporting any safety-relevant failures and previously unidentified hazards. FRA seeks to continue this relationship requirement for mandatory PTC system installations under the provisions of this subpart.

As noted in the preamble discussion of § 236.907(d), FRA clearly indicated that if there was "a breakdown in communications that could adversely affect public safety", FRA would take appropriate action as necessary. See 70 FR 11,052, 11,074. FRA also noted that the language of § 236.907 "place[d] a direct obligation on suppliers to report safety-relevant failures, which would include 'wrong-side failures' and failures significantly impacting on availability where the Product Safety Plan indicates availability to be a material issue in the safety performance of the larger railroad system." 70 FR 11,052, 11,074. This provision was necessary to ensure public safety in the event where a commercial dispute (e.g., over liability) might disrupt communications between a railroad and its supplier.

FRA believes that the requirement that a product supplier notify FRA, in addition to the affected railroads, of safety-relevant failures of the PTC product discovered by the supplier does not add to the complexity or cost of PTC system deployment. The addition of FRA to the list of entities that must be notified in the unlikely event of a product failure that has been identified by the product supplier adds only marginally to the level of effort required of the product supplier. As a condition of providing PTC systems pursuant to subpart H of this part, the product supplier must already maintain a list of parties that require such notification. As GE noted, even if there were no regulatory requirement for a mutual reporting relationship between product suppliers and railroads, there are already legal incentives for a supplier to quickly resolve any safety related failure. FRA believes that these legal incentives should motivate the product supplier to promptly notify product users of safety-related issues and, therefore, to maintain a list of product users.

FRA has also considered GE's argument that the railroad is the primary entity having knowledge of safety-related failures and already has an obligation to report the failure within strict guidelines. Thus, even if the PTC supplier becomes aware of the failure, the supplier may not have sufficient understanding of the failure to determine whether it is safety-related in nature without talking to the railroad. GE's assertion that the supplier may not recognize that a failure is safety related without talking to the railroad also applies equally to the converse situation. A railroad may report a failure to the vendor or supplier that the railroad may not recognize as safety critical, and it is only the vendor's or supplier's detailed knowledge of the product that enables recognition of the failure as safety critical.

FRA is consequently unmoved by the assertion that the imposition of a requirement that a vendor or supplier notify FRA upon discovery of a safety critical problem would be unduly burdensome. In view of the preceding, FRA has left this paragraph unchanged in principle. FRA has, however, made editorial changes to more clearly define the responsibilities of the parties involved and to clearly indicate the acceptability of incremental reporting as more information becomes available.

RSI made many statements similar to those of GE and also asserts that the notification requirement on suppliers would not enhance safety, but would create the potential for redundant, premature, potentially misleading, and burdensome reports to FRA. RSI cites various statutes and regulations, including RSIA08 and the existing part 236, that apply "exclusively" to "railroads" and "railroad carriers." However, according to 49 USC § 20103, which continues to be referenced in part 236's Authorities section:

> **(a) Regulations and orders.**--The Secretary of Transportation, as necessary, shall prescribe regulations and issue orders for every area of railroad safety supplementing laws and regulations in effect on October 16, 1970. When prescribing a security regulation or issuing a security order that affects the safety of railroad operations, the Secretary of Homeland Security shall consult with the Secretary.

Thus, FRA has jurisdiction "for every area of railroad safety." Subpart I supplements the laws and regulations in effect on October 16, 1970. Moreover, while the U.S.C. provisions cited by RSI apply to railroads and railroad carriers, there is nothing in those provisions restricting FRA's jurisdiction over other entities or persons.

FRA has previously applied its jurisdiction over suppliers. Under § 236.907(d), suppliers must perform certain notification responsibilities. While that paragraph concerns notification by the supplier to the railroad, there is nothing preventing FRA from requiring the supplier to also notify FRA. In fact, as a practical matter, FRA believes that reporting failures directly to FRA is necessary here. Under subpart H, the absence of direct and timely access to product notices has continued to be an issue for FRA. This concern will only become greater as the subject technology becomes more complex.

RSI also noted that, “the scope of the signal and train control provision at Part 236 explains that this entire part, which will include the proposed regulations for § 236.1023, applies only to the railroads.” Indeed, § 236.0(a) currently states, “Except as provided in paragraph (b) of this section, this part applies to all railroads.” While that paragraph indicates that the part applies to all railroads, it does not limit application to “only” railroads, as misstated by RSI. In any event, to avoid confusion, FRA is modifying § 236.0(a) to apply to all railroads and persons as indicated in this part. For instance, “person” is defined in § 236.0(f) when referencing 1 U.S.C. § 1 (which includes manufacturers and independent contractors) and railroad is defined in subpart G of part 236.

Paragraph (i) addresses situations which are clearly not the result of a design or manufacturing issue, and limits unnecessary reporting. If the failure, malfunction, or defective condition was the result of improper operation of the PTC system outside of the design parameters or of non-compliance with the applicable operating instructions, FRA believes that compliance with paragraph (e) is not necessary. Instead, FRA expects and requires the railroad to engage in more narrow remedial measures, including remedial training by the railroad in the proper operation of the PTC system. Similarly, once a problem has been identified to all stakeholders, FRA does not believe it is necessary for a manufacturer to repeatedly submit a formal report in accordance with paragraph (h). In either situation, however, FRA expects that all users of the equipment will be proactively and timely notified of the misuse that occurred and the corrective actions taken.

Such reports, however, do not have to be made within fifteen days of occurrence, as required for other notifications under paragraph (f), but within a reasonable time appropriate to the nature and extent of the problem.

Paragraph (j) has been added to the final rule to require that, when any safety-critical PTC system, subsystem, or component fails to perform its intended function, the railroad is required to determine the cause and perform necessary adjustment, repair, or replacement of any faulty product without undue delay. Paragraph (j) also reminds railroads that, until corrective action has been completed, a railroad is required to take appropriate action to ensure safety and reliability as specified within its PTCSP.

In paragraph (k) of the final rule, FRA intends to make it absolutely clear that the reporting requirements of part 233 are not a substitute for the reporting requirements of this subpart, nor are the reporting requirements of this subpart considered to be a substitute for the reporting requirements of part 233. Both sets of reporting requirements apply. FRA would like to clarify that both requirements apply. In the case of a failure meeting the criteria described in § 233.7, FRA would not expect the railroad to wait for the frequency of such occurrences to exceed the threshold reporting level assigned in the hazard log of the PTCSP, but will expect the railroad to report the occurrence as required by § 233.7.

This provision is a key part of any performance standard, and parallels current requirements under subpart H. The costs and benefits of this section are included in the general analysis below.

4.20 Section 236.1027, Exclusions

This section retains similarities to, but also establishes contrasts with, § 236.911, which deals with exclusions from subpart H. In particular, § 236.911(c) offers reassurance that a stand-alone computer aided dispatching (CAD) system would not be considered a safety-critical processor-based system within the purview of subpart H. CADs have long been used by large and small railroads to assist dispatchers in managing their workload, tracking information required to be kept by regulation, and—most importantly—providing a conflict checking function designed to alert dispatchers to incipient errors before authorities are delivered. Even § 236.911, however, states that "a subsystem or component of an office system must comply with the requirements of this subpart if it performs safety-critical functions within, or affects the safety performance of, a new or next-generation train control system." FRA continues to work with a vendor on a simple CAD that provides authorities in an automated fashion, without the direct involvement of a dispatcher.

For subpart I, FRA wishes to retain the exception referred to in § 236.911 for CAD systems not associated with a PTC system. Many smaller railroads use CAD systems to good effect, and there is no reason to impose additional regulations where dispatchers contemporaneously retain the function of issuing mandatory directives. However, in the present context, it is necessary to recognize that PTC systems utilize CAD systems as the "front end" of the logic chain that defines authorities enforced by the PTC system, particularly in non-signaled territory.

Accordingly, paragraph (a) provides for the potential exclusion of certain office systems technologies from subpart I compliance. These existing systems have been implemented voluntarily to enhance productivity and have proven to provide a reasonably high level of safety, reliability, and functionality. FRA recognizes that full application of subpart I to these systems would present the rail industry with a tremendous burden. The burdens of subpart I may discourage voluntary PTC implementation and operation by the smaller railroads.

However, subpart I applies to those subsystems or components that perform safety critical functions or affect the safety performance of the associated PTC system. The level and extent of safety analysis and review of the office systems will vary depending upon the type of PTC system with which the office system interfaces. For example, to prevent the issuance of overlapping and inconsistent authorities, FRA expects that each PTC system demonstrate sufficient credible evidence that the requisite safety-critical, conflict resolution (although not necessarily vital) hardware and software functions of the system will work as intended. FRA also expects that the applicable PTCDP's and PTCSP's risk analysis will identify the associated hazards and describe how they have been mitigated. Particularly where mandatory directives and work authorities are evaluated for use in a PTC system use without separate oral transmission from the dispatcher to the train crew or employee in charge—with the opportunity for receiving personnel to evaluate and confirm the integrity of the directive or authority received and the potential for others overhearing the transmission to note conflicting actions by the dispatching center—FRA will insist on explanations sufficient to provide reasonable confidence that additional errors will not be introduced.

Paragraph (b) provides requirements for modifications of excluded products. At some point changes to excluded products are significant enough to require the safety assurance processes of subpart I to be followed. This point exists when a change results in degradation of safety or in a material increase in safety-critical functionality. FRA believes that all modifications caused by implementation details will not necessarily cause the product to become subject to subpart I. These types of implementation modifications will be minor in nature and be the result of site specific physical constraints. FRA expects that implementation modifications that will result in a degradation of safety or a material increase in safety-critical functionality, like a change in executive software, will cause the product to be subject to subpart I and its requirements. FRA is concerned, however, that a series of incremental changes, while each individually not meeting the threshold for compliance with this subpart, may when aggregated result in a product which differs sufficiently as to be considered a new product. FRA therefore reserves the right to require products that have been incrementally changed in this manner to comply with the requirements of this subpart. Prior to FRA making such a determination, the affected railroad will be allowed to present detailed technical evidence why such a determination should not be made. This provision mirrors paragraph (d) of existing § 236.911.

Paragraph (c) addresses the integration of train control systems with other locomotive electronic control systems. The earliest train control systems were electro-mechanical systems that were independent of the discrete pneumatic and mechanical control systems used by the locomotive engineer for normal throttle and braking functions. Examples of these train control systems included cab signals and ACS/ATC appliances. These systems included a separate antenna for interfacing with the track circuit or inductive devices on the wayside. Their power supply and control logic were separate from other locomotive functions, and the cab signals were displayed from a separate special-purpose unit. Penalty brake applications by the train control system bypassed the locomotive pneumatic and mechanical control systems to directly operate a valve that accomplished a service reduction of brake pipe pressure and application of the brakes as well as reduction in locomotive tractive power. In keeping with this physical and functional separation, train control equipment onboard a locomotive came under part 236, rather than the locomotive inspection requirements of part 229.

Advances in technology have presented the capability for allowing original equipment manufacturers (OEMs) of the various components making up the locomotive and the train control systems began individually repackaging the individual components using the enhanced microprocessor capabilities and eliminating parts and system function control points access. Access to control functions became increasingly restricted to the processor interfaces using proprietary software. While this resulted in significant simplification of the previously complex discrete pneumatic and mechanical control train and locomotive control systems into fewer, more compact and reliable devices, it also creates significant challenges with respect to compatibility of the application programs and configuration management.

FRA encourages such enhancements, and believes, if properly done, can result in significant safety, as well as operational, improvements. Locomotive manufacturers can certainly provide secure locomotive and train controls, and it is important that they do so if locomotives are to function safely in their normal service environment. FRA highly encourages the long-term goal of common platform integration. However when such an integration occurs, it must not be done at the expense of decreasing the safe, and reliable operation of the train control system.

Accordingly FRA expects that the complete integrated system will be shown to have been designed to fail safe principles, and then demonstrated that the system operates in a fail safe mode. Any commingled system must have a manual failsafe fall back up that allows the engineer to be brought to be a safe stop in the event of an electronic system failure. This analysis must be provided to FRA for approval in the PTCDP and PTCSP as appropriate. This provision mirrors the heightened scrutiny called for by §236.913(c) of subpart H for commingled systems, but is more explicit with respect to FRA's expectations. The provision in general accords with the requirements for locomotive systems that are currently under development in the RSAC's Locomotive Safety Standards Working Group.

GE generally agreed with the preceding discussion about separate regulatory treatment of PTC and the Locomotive Control Systems. However they strongly disagree with any implication, if the two systems were interfaced or commingled, that PTC requirements could be extended into the Locomotive Control System. They assert non safety-critical data can be passed between the systems using appropriate interfaces without any impact on safety and without triggering a need to extend PTC requirements into the control system.

FRA agrees that there are implementation techniques that allow for locomotive control systems to passively receive information from a train control system, and the train control and locomotive control systems are not tightly coupled. FRA expects that in such situations the safety case for the train control system clearly and unequivocally demonstrates that the train control system it is not tightly coupled with the locomotive control system, and that failures in the locomotive control system have absolutely no adverse consequences on the safe operation of the train control system. Likewise, FRA expects that the safety analysis for the locomotive control system clearly, and unequivocally demonstrates that the train control system it is not tightly coupled with the locomotive control system, and that failures in the train control system have absolutely no adverse consequences on the safe operation of the locomotive control system. If the safety analysis cannot convincingly demonstrate to FRA that the train control and locomotive control systems are loosely coupled, then FRA will require that the safety analysis for the PTC system include the applicable elements of the locomotive control system, and vice versa.

Finally paragraph (d) clarifies the application of subparts A through H to products excluded from compliance with subpart I. These products are excluded from the requirements of subpart I, but FRA expects that the developing activity demonstrates compliance of products with subparts A through H. FRA believes that railroads not mandated to implement PTC, or are implementing other non PTC related processor based products ought to be given the option to have products which are made subject to subpart H by submitting a PSP and otherwise complying with subpart H or voluntarily complying with subpart I. This provision mirrors § 236.911(e) of subpart H.

This section adds considerable flexibility, and does not add to costs, nor does it reduce any benefits. The costs outlined below are calculated assuming the existence of this section.

4.21 Section 236.1029, PTC System Use

This section establishes minimum requirements, in addition to those found in the PTCDP PTCSP, for PTC system use after approval. Railroads are allowed, and encouraged, to adopt more restrictive rules that increase safety.

Paragraph (a) requires that, in the event of the failure of a component essential to the safety of a PTC system to perform as intended, the cause be identified and corrective action taken without undue delay. The paragraph also requires that until repair is completed, the railroad is required at a minimum, to take the measures specified in the PRCSP as well as any other appropriate measures to assure the safety of train movements, roadway workers, and on-track equipment. This requirement mirrors current requirement § 236.11, which applies to all signal and train control system components. FRA will apply the current standard in § 236.11 to PTC systems certified under Subpart I.

Paragraph (b) provides the circumstance where a PTC onboard apparatus on a controlling locomotive that is operating in or is to be operated within a PTC system fails or is otherwise cut-out while en route. Under paragraph (b), the subject train may only continue such operations in accordance with specific limitations. An en route failure is applicable only in instances after the subject train has departed its initial terminal, having had a successful initialization, and subsequently rendering it no longer responsive to the PTC system. For example, FRA believes that an en route failure may occur when the PTC onboard apparatus incurs an onboard fault or is otherwise cut out.

Under subpart H, existing § 236.567 provides specific limitations on each train failing en route in relation to its applicable automatic cab signal, train stop, and train control system. FRA believes that it would be desirable to impose somewhat more restrictive conditions given the statutory mandate and the desire to have an appropriate incentive to properly maintain the equipment and to timely respond to en route failures. For instance, FRA recognizes that the limitations of § 236.567 do not account for the statutory mandates of the core PTC safety functions.

During the PTC Working Group meetings prior to issuance of the NPRM, no consensus was reached on how to regulate en route failures on PTC territory. However, FRA subsequently received several comments that the en route failure requirements and the restrictive operational conditions imposed by paragraph (b) are burdensome and overly restrictive.

When the PTC Working Group was reconvened following the Public Hearing and the NPRM comment period, the PTC Working Group formed three separate task forces for the purpose of discussing and resolving several specific issues. One such task force, deemed the Operational Conditions Task Force, was assigned the task of resolving the issues associated with operational limitations presented in the proposed rule associated with temporary rerouting within § 236.1005, unequipped trains operating within a PTC system within § 236.1006, and en route failures within § 236.1029.

The proposed rule provided allowances for deviations from the restrictions of operations exceeding 90 miles per hour if such deviations were presented and justified in an FRA approved plan. At the PTC Working Group meeting, it was recommended that the procedure allowing for such deviations equally apply to all other operations, regardless of the speed of the operations.

Upon presentation of these recommended revisions to the PTC Working Group, Amtrak and NJ Transit withheld consensus, requesting rather to state on the record that they believed the requirement for the establishment of an absolute block was overly burdensome and unnecessary, and the operational limitations were too restrictive in areas where an underlying block signal system and/or cab signal system with train stop/train control functions remained in place. They further suggested that the operational restrictions for en route failures should be solely presented and described within a railroad's PTCDP and PTCSP, which would then be applicable to a particular PTC system.

FRA appreciates the concerns presented. However, FRA remains convinced that the rule text must provide a "baseline" for operational restrictions associated with en route failures within all PTC systems, with the recognition of the allowance for a railroad to submit a request for deviation from those requirements, with justification, within their PTCDP and PTCSP for FRA approval. Accordingly, FRA has substantially adopted into paragraphs (b) and (c) the text proposed at the PTC Working Group meeting.

Section 236.1029, and in particular paragraph (b), purposefully parallels the limitations contained in § 236.567. In other words, FRA intends that § 236.567 and paragraph (b) of this section will share the common purpose of maintaining a level of safety generally in accord with that expected with the train control system fully functional. This is accomplished by requiring supplementary procedures to heighten awareness and provide operational control (limiting the frequency of unsafe events) and by restricting the speed of the failed train (reducing the potential severity of any unsafe event).

Paragraph (b)(1) allows the subject train to proceed at restricted speed—or at medium speed if a block signal system is in operation according to signal indication—to the next available point where communication of a report can be made to a designated railroad officer of the host railroad. The intent of this requirement is to ensure that the occurrence of an en route failure may be appropriately recorded and that the necessary alternative protection of absolute block is established.

NYSMTA provided comments recommending that paragraph (b)(1) of this section cite 40 miles per hour as the maximum permissible speed within a failed PTC system where a block signal system is in operation because some railroads, such as the LIRR and Metro-North, have defined medium speed lower than what the FRA regulation would permit. FRA defines medium speed in § 236.811 as "A speed not exceeding 40 miles per hour." Thus, we believe the rule is clear in terms of the applicable maximum speed limit and consistent with the suggestions made by NYSMTA.

While a particular railroad may internally define “medium speed” differently, the definitions contained in part 236 control the meaning of the terms used therein.

After a report is made in accordance with paragraph (b)(1), or made electronically and immediately by the PTC system itself, paragraph (b)(2) allows the train to continue to a point where an absolute block can be established in advance of the train in accordance with the limitations that follow in paragraphs (b)(2)(i) and (ii). Paragraph (b)(2)(i) requires that where no block signal system is in use, the train may proceed at restricted speed. Alternatively, under paragraph (b)(2)(ii), the train may proceed at a speed not to exceed medium speed where a block signal system is in operation according to signal indication.

Paragraph (b)(3) requires that, upon the subject train reaching the location where an absolute block has been established in advance of the train, the train may proceed in accordance with the limitations that follow in paragraphs (b)(3)(i), (ii), or (iii). Paragraph (b)(3)(i) requires that where no block signal system is in use, the train may proceed at medium speed; however, if the involved train is a train which is that of the criteria requiring the PTC system installation (i.e., a passenger train or a train hauling any amount of PIH material), it may only proceed at a speed not to exceed 30 miles per hour. Paragraph (b)(3)(ii) requires that where a block signal system is in use, a passenger train may proceed at a speed not to exceed 59 miles per hour and a freight train may proceed at a speed not to exceed 49 miles per hour. Paragraph (b)(3)(iii) requires that, except as provided in paragraph (c), where a cab signal system with an automatic train control system is in operation, the train may proceed at a speed not to exceed 79 miles per hour.

The Rail Labor Organizations believe that the rule is too permissive for en route failures of a PTC system where an underlying signal system is not governing train movements, as they assert that any train invisible to the PTC system in PTC territory presents an unacceptable risk. Instead, asserts the RLO, treatment of en route failures should parallel the restrictions required when a train experiences a signal failure, such as a switch position that is unknown or when a route is not known to be clear. While the NPRM proposed to allow a passenger or PIH PTC train in dark territory to traverse a switch in an unknown position at medium speed or 30 miles per hour, the RLO asserts that such trains should be limited to restricted speed or other methods, such as temporal separation.

FRA appreciates the RLO’s concerns. However, FRA believes that the proposal to limit operations to restricted speed, or employ other protective methods such as temporal separation, would be too burdensome and unwarranted. FRA has elected to keep the language of the NPRM in this final rule for several reasons. First, it is expected that failures en route addressed by this rule, as well as temporary rerouting that could result in its application, will not occur on any frequent basis. Experience and requirements of other portions of this subpart would preclude this from being the case. Second, the assertion that “any train invisible to the PTC system in PTC territory presents an unacceptable risk” is inaccurate. Such a train would not in fact be “invisible” to the PTC system as there remains in place some type of authority for the train’s movement, and all authorities of other trains that would be PTC-equipped would be enforced by the system. Additionally, the maximum speed of 30 miles per hour established by FRA for these situations is based on extensive analysis of past accident and incidence data, which has shown that train accidents at or below 30 miles per hour have not resulted in breach or compromise of cars carrying hazardous materials. FRA has elected to keep this language of the NPRM in this final rule.

Paragraph (c) requires that, in order for a PTC train to deviate from the operating limitations contained in paragraph (b) of this section, the deviation must be described and justified in the FRA approved PTCDP or PTCSP. Amtrak had presented comments regarding the NPRM, as well as within the PTC Working Group task force assigned to address comments received regarding this section, asserting that the operational limitations of failure en route were too restricting and unwarranted. Directly in response to those comments, FRA may allow for deviation from the identified limitations of the rule if that deviation is described and justified in the applicable and FRA approved PTCDP, PTCSP, or Order of Particular Applicability. Furthermore, the speed threshold of 90 miles per hour proposed in the NPRM has been removed. FRA will consider deviation proposals for conventional operations, as well as high-speed operations. FRA continues to anticipate that existing operations on the Northeast Corridor will not be adversely impacted, since failure of one component of the onboard train control system will permit the remaining portion to function and provide for a reasonable level of safety.

Paragraph (d) requires that the railroad operate its PTC system within the design and operational parameters specified in the PTCDP and PTCSP. Railroads will not exceed maximum volumes, speeds, or any other parameter provided for in the PTCDP or PTCSP. On the other hand, a PTCDP or PTCSP could be based upon speed or volume parameters that are broader than the intended initial application, so long as the full range of sensitivity analyses is included in the supporting risk assessment. FRA feels this requirement will help ensure that comprehensive product risk assessments are performed before products are implemented.

Paragraph (e) sets forth the requirement that any testing of the PTC system must not interfere with its normal safety-critical functioning, unless an exception is obtained pursuant to 49 CFR § 236.1035, where special conditions have been established to protect the safety of the public and the train crew. Otherwise, paragraph (e) requires that each railroad ensure that the integrity of the PTC system not be compromised, by prohibiting the normal functioning of such system to be interfered with by testing or otherwise without first taking measures to provide for the safety of train movements, roadway workers, and on-track equipment that depend on the normal safety-critical functioning of the system. This provision parallels current § 236.4, which applies to all systems. By requiring this paragraph, FRA also intends to clarify that the standard in current § 236.4 also applies to subpart I PTC systems.

Paragraph (f) requires that each member of the operating crew has appropriate access to the information and functions necessary to perform his or her job safely when products are implemented and used in revenue service. FRA expects paragraph (f) to automatically require each engineer operating the controlling locomotive to have access to the PTC display providing such information. Paragraph (f) also applies to other crew members assigned duties in the locomotive cab. The rule is a performance standard which can be met several different ways,

Train crews perform as a team and are required by railroad and FRA rules to do so. The importance of having assigned crew members fully involved in train operations is also clearly the intent of Congress in the RSIA. The Congress mandated the certification of the conductor to work in concert with the already federally-certified locomotive engineer. For the conductor and engineer to fulfill the expectations of Congress, it is necessary for both crewmembers have sufficient information to perform their duties. For the conductor to be able to fulfill the assigned obligations, the conductor must have ready access to certain information, including the authority information being received from the dispatcher. As described below, FRA believes that safety would be materially diminished if the conductor in freight operations were denied access to the same information in the same format as the engineer.

For instance, under the operating rules or special instructions of the major freight railroads, each train crew member in the performance of his or her duties receives copies of a fair amount of paperwork that includes the train consist, which provides the number, loading, locations, and hazardous materials contents of cars, the length and weight of the train, General Orders, which provide loose footing issues, the safety rules of the day or week, security reminders, temporary speed restrictions, and the locations of maintenance of way crews performing track repairs. This paperwork provides the train crew with the work plan necessary to operate the assigned train during their tour of duty. Once the crew is underway, the conductor receives from the dispatcher via radio updates to the above information (and provides acknowledgment back to the dispatcher), transcribes hand written copies, and provides those copies to the engineer and other crew members (in lieu of stopping if engineer only). Each crew member keeps these copies in front of them (usually on a desk) for ready reference to approaching speed restrictions and working limits of roadway workers. Upon these documents, crew members make hand written notes and are required to write "void" across superseded or expired movement authorities. In case any questions pertaining to crew performance arise later, each crewmember keeps these copies. Particularly in a PTC overlay system, which by definition depends upon all continued performance of all of the safety-related functions of the underlying system of operation, all of these functions must continue to be performed either as they are now or in an equivalent manner. Removing or impairing any of those functions will diminish safety.

The conductor is responsible for determining the train consist and for ensuring compliance with hazardous materials train placement requirements. The conductor is also responsible for determining whether one or more cars in the train is restricted (e.g., requirement regarding appropriate placement in the train or speed restriction limiting the train's speed to avoid a derailment hazard).[12] Conductors are regularly disciplined in certain situations, including when the limits of authorities are violated or maximum speed limits are exceeded.

Moreover, in present cab signal territory, multiple crew members rely on the information provided by the cab signal display, typically mounted in the center of the cab or other conspicuous location. ACSES displays have also been centrally mounted in passenger and freight cabs for clear visibility.[13] Under this final rule, cab signals may continue to operate independently of the PTC display of the locomotive cab. However, based upon RSAC discussions, FRA is confident that

[12] Enforcement of a speed restriction associated with a particular car is not a mandated PTC function, but is an important function that will be provided within the Interoperable Train Control architecture for the general freight system.

[13] ITCS displays in freight locomotives have not been mounted so as to be clearly visible to freight crews. The subject line is principally used for passenger service, and the number of freight locomotives involved has been very small. ITCS has been permitted to operate under waiver, and FRA freely concedes that the issue of freight crew display visibility had not been clearly joined to this point.

PTC displays may (and probably will) supplant current cab signal displays and utilize the cab signal code as an input to the PTC display.[14] Section 236.515 has long provided that "The cab signals shall be plainly visible to member or members of the locomotive crew from their stations in the cab." Positive train control systems will play a role very similar to, but in fact even more important than, automatic cab signals have played in the territories where installed. In addition to providing current displays (or "targets") for signal indications, FRA expects that PTC will also display in graphic form slow orders and other mandatory directives.

FRA recognizes that PTC systems are being designed to move much of this information into an electronic format. The intent of utilizing electronic transmission of authorities is to reduce human error associated with listening, copying, and reading back of updates over voice channels while the train crew is en route. Regardless if the information is transmitted digitally or verbally, the goal is to prevent the train from occupying the main track without authority, to prevent most over-speed issues, and to stop short of misaligned switches if the crew fails to follow the rules. While FRA supports this transition to digital communications, this final rule does not require it.

In the event that a certified PTC system does use digital transmissions to provide communications and acknowledgement of mandatory directives between the dispatcher and conductor, to allow the conductor to electronically input the train consist into the PTC system, or otherwise similarly modify a crew member's responsibilities, FRA expects under paragraph (f) that the subject crew member will be afforded appropriate access to the PTC system display to fulfill those responsibilities.

In its comments, the AAR also indicated that railroads have been planning to put a single display in locomotive cabs for the engineer in systems which FRA has already approved and that this requirement was redundant and excessive, referring to the BNSF ETMS system. The AAR questioned the need for a conductor to have access to a PTC display. The Class I railroads have attempted to present the case that FRA had previously blessed the implementation of PTC technology that would permit electronic delivery of mandatory directives while discontinuing the delivery of printed or voice transmitted directives. However, that is not the case.

The system to which AAR refers—BNSF's ETMS I configuration—was qualified under subpart H, which only requires that the system be at least as safe as existing systems and the approval was limited in material ways the AAR failed to mention. Subpart I, however, requires that non-vital overlay systems reduce the likelihood of PTC preventable accidents by at least 80%. Subpart H does not address or require interoperability, but subpart I requires interoperability.

The BNSF ETMS I configuration concept of operations was a pure non-vital overlay on the existing method of operations. The safety analysis for that system assumed that the conductor would continue to receive mandatory directives in the normal manner. BNSF, the only railroad to obtain authority for use of a first-generation freight PTC system, very heavily justified its safety

[14] In vital applications, reliance on these displays will be authorized and required. Although initially in-block signal upgrades may not be permitted to be acted upon, except in cab signal territory, FRA has no doubt that the ability to upgrade between wayside signals will be requested as the technology is proven reliable. According to the major railroads involved in the Interoperable Train Control effort, most Class I locomotives will need to be configured to operate essentially in any territory on the system.

case on the assumption that crewmembers would intervene should the PTC system experience a wrong-side failure (which could occur due to a software error, hardware malfunction, database error, or combination of these factors). This system was justified as an "overlay" on the existing method of operations; while there would be only one PTC display screen, it was contended that most wrong-side errors would be caught by crewmembers holding mandatory directives in paper form. This type of existing PTC system, which has only been deployed by BNSF on a few lines and with very few locomotives equipped, precludes one-half of the train crew from having any access to the information for which they are held accountable. This has been tolerable only because both crew members do have a full set of printed or written directives.

Note that basic interoperability is potentially a concern with respect to the human-machine interface and means by which FRA addresses it. To the extent a locomotive from a railroad which uses only voice transmission of mandatory directives were to travel on a railroad using electronic transmission of mandatory directives, it would need to be equipped for the other railroad. Yet none of the major freight railroads has conducted a revenue demonstration of a system that relies exclusively on electronic transmission of authorities; and, after more than two decades of development and demonstrations, the major freight railroads have still not issued interoperability standards. Even if FRA were able to accept some of the arguments proffered in regard to the need for access to PTC information, addressing this issue through review of individual railroad plans would not be feasible. This issue needs to be settled "up front" in order to support an orderly implementation.

The testimony and written filings in this docket reflected a serious misunderstanding regard the distinctions noted above and the posture of the BNSF Product Safety Plan review. The AAR and CSXT both asserted that FRA has approved use of a single screen in the form of BNSF ETMS I configuration. More remarkably, BNSF itself testified at the public hearing that, "As approved by FRA, our locomotive cab configuration includes one display screen, which is positioned on the dashboard of the engineer." Comment of BNSF Railway Company, Docket FRA-2008-0132.0011.1 (Aug. 19, 2009); Positive Train Control Systems: Hearing Before the Fed. Railroad Admin. (Aug. 13, 2009) (statement of Mark Schulze, Vice President, BNSF Railway Company). In fact, FRA's decision letter for that system stated as follows:

> 7. Prior to any further ETMS Configuration I operations, BNSF must either comply with 49 CFR § 236.515 (Visibility of cab signals), or submit a risk-based justification as to why the requirements of this rule should be waived. The justification shall be submitted in accordance with the PSP amendment procedures in 49 CFR § 236.913. (FRA Docket No. 2006-23687, Document No. 0021.)

The subject approval remains contingent as of the date of preparation of this final rule, since the railroad has not submitted the required justification.[15]

[15] Prior to enactment of the RSIA08, FRA had taken significant steps to encourage voluntary PTC deployment, including offering the inducement of exceptions from traditional train control requirements. Had BNSF submitted a detailed justification for the single display visible only to the locomotive engineer, it is entirely possible that it would have been approved, since the performance standard under subpart H presents a very low bar for a reasonably competent train control system when applied in non-signaled or traffic control territory and since under the ETMS PSP the conductor would either continue to receive mandatory directives in writing or would copy mandatory directives

The AAR also misstates the extent of the Volpe Center's review of ETMS. From the Volpe Center's review: "The purpose of the analysis was to assess the extent to which the ETMS system follows accepted human factors design guidelines that are likely to catch and correct potential human performance problems." Volpe did not perform a "thorough human factors analysis" as posited by AAR. Rather, Volpe focused on the user interface for locomotive engineers, identifying issues within the existing design (which was still under development) and within the concept of operations as defined by the railroad.

Once all of the paperwork is moved into electronic transmissions (which has been neither formally requested nor in any way justified under existing regulations), in the absence of an available display one-half of the train crew would not have the ability to review and receive updates while en-route, or keep records of the movement authorities and restrictions for future use. PTC is currently an imperfect technology fed by databases that can be corrupted. Mandatory directives will continue to be issued by dispatchers with limited conflict checking using non-vital computer-aided dispatching systems. As the point paper orders are no longer provided, and mandatory directives are issued electronically en route, there would be no general broadcast on the "road channel" that could lead to other train crews or roadway workers identifying a defective authority (e.g., a mandatory directive to traverse a track segment already occupied by another train). None of the freight railroads has yet demonstrated how the transition to full electronic delivery of mandatory directives will be accomplished. FRA believes that the transition will eventually be made, but in the initial period it is critical that existing provisions for safety—which work very well a very high percentage of the time—including appropriate access to the PTC system display not be prematurely abandoned. Although FRA agrees that transmission of valid authorities should be more secure, and thus the trade-off is likely to be favorable, FRA sees no reason at this time to take a second or third crew member out of the loop or to load on the engineer the responsibility for both receiving mandatory directives and briefing the second or third crew member who will be expected under the railroad's rules to comply.

FRA believes it is important to the risk assessment process that the engineer and conductor perform at a level no less safe than they would have had there not been a PTC system. The PTC systems proposed for freight railroads are overlay systems. In an overlay system, the railroad adds a layer of safety to the existing operation. The risk assessment then is relatively easy, because it is easy to show that the new system adds safety, reducing the risk of certain accidents, while not adding any new risk. The key assumption of the risk assessment is no degradation of the underlying safety system, and the performance of crewmembers is a key element of that safety system.

It is impossible at present to quantify the additional risk associated with adding a task which compromises the safe operation of the train by the engineer or conductor, even if only for a short time. Engineers and conductors have an excellent record of avoiding accidents. PTC seeks to improve upon that excellent record. The existing human factors literature leads one to believe that

transmitted verbally by the dispatcher via radio. 49 CFR § 236.909(a). The point here is that, if the railroad had indeed conducted adequate human factors analysis, it had not been submitted to FRA; and no implications should be drawn with respect to this very different context, wherein interline operation of locomotives is at stake and several major railroads clearly wish to abandon traditional means of delivering authorities.

entering complex acknowledgements into a PTC system while the train is in motion is a very significant risk. To quantify that risk one would have to put it into the context of comparative safety using a human factors model far more complex and accurate than any of which FRA is aware. Also note that PTC does not address all accident scenarios, many of which are often avoided by timely locomotive engineer intervention. The timeliness of such intervention is dependent on situational awareness, which would be negatively impacted if the engineer were distracted. Reading text on a PTC screen appears to be as distracting as reading text on a cell phone or PDA and texting in reply. In order for FRA to accept the diversion of the engineer's attention which would come from having the engineer review and accept the mandatory directives while the train is motion, FRA would need a process different from the current risk assessment methodology. That in turn would require FRA to impose a specification standard, instead of a performance standard. Were FRA issuing only a specification standard, FRA would require the second display and input unit.

In short, the rule as it stands relies on comparing system risk, which is easy if the engineer is not distracted by the system, but impossible if the engineer might be distracted. What we do know with certainty is that having the engineer read and respond to lengthy written messages on the PTC screen would be a distraction resulting in greater risk exposure which would offset to some extent the risk reduction resulting from PTC systems.

AAR argues that the requirement in §236.1029(f) pertaining to distraction of the locomotive engineer should be deleted. The AAR claims that FRA does not offer any study showing that safety is jeopardized by assigning the engineer PTC-related duties. FRA has directly observed engineers exceeding authorities while attempting to respond to PTC system requirements on tests of existing PTC systems. In those cases, the engineer was attempting to respond to digitally transmitted authority while the train was in motion and was plainly distracted from safety-critical duties. FRA does not need a study to verify the possibility of that which it has observed directly.

The AAR also raises an issue of accuracy in transmitting and receiving mandatory directives, and appears to make the argument that because electronic transmission of mandatory directives is likely to be much more accurate than voice communication of mandatory directives, that all will be safer if mandatory directives are transmitted electronically. FRA agrees that the electronic transmission is likely to be more accurate, but does not agree that accurate transmission is the only safety issue. FRA is concerned with procedures which might distract the engineer from his duties. There is no problem if the railroad intends to have engineers receive, review, and acknowledge mandatory directives, unless the railroad wants the engineer to perform that task with the train in motion, and provided the engineer can take the time to brief other crew members, who under current railroad operating rules would need to copy and retain the orders.

All systems of which FRA is aware will require the crew to acknowledge the mandatory directives. FRA has seen system designs that would permit acknowledgement by simply pressing a button. There is no reason to believe that simply pressing a button demonstrates understanding of a mandatory directive, and FRA does not intend to approve such systems because they will not provide an adequate level of safety. Simply pressing a button does not provide the evidence of comprehension and mutual understanding currently provided by the practice of reading mandatory directives back to the dispatcher over the radio. Even if this means of acknowledgment is elected and approved by FRA, it would be necessary for an engineer receiving such a directive to read it and consider its relevance to the current situation. This could distract the engineer from actions needed to address other restrictions or an emerging situation on the railroad (e.g., need to warn equipment or personnel unexpectedly fouling the track ahead, requirement to manage a train over undulating terrain to avoid excessive in-train forces, emergency use of the train horn because of vehicle storage on the tracks in a quiet zone).

FRA believes that simply referencing the default PTC display screen will be consistent with good situational awareness and should not present a problem. However, excessive engagement with the PTC onboard computer while underway can distract a locomotive engineer from current duties. While acknowledgment by use of a single soft key may limit the distraction associated with manipulation of the device, it does not address whether the directive was understood. It is also possible to create greater interaction with the onboard computer while causing distraction and yet still not ensure that the directive is understood. For instance, a system tested by one railroad required an eight digit acknowledgment code to confirm receipt of a mandatory directive. In prototype testing locomotive engineers attempting to enter the code have exceeded their authority, because entering a code is a distraction similar to text messaging (a prohibited practice).[16]

In those cases where train consist information needs to be adjusted and confirmed in the PTC system, having that done by the conductor will eliminate a potential source of error. (Provision of input capability on the conductor's terminal will also (if so elected) avoid delays in train starts associated with multiple crews attempting to work out consist information over the radio or a cell phone link to the central office.)   Having the conductor observe displayed PTC system data should also provide an additional opportunity for early identification of problems with mandatory directives and displayed information that may derive from corrupted databases, computational errors, or erroneous mandatory directives.

The purpose of paragraph (f) is to ensure that those assigned tasks in the cab are able to perform those tasks, including constructive engagement with the PTC system. Furthermore, while the train is moving, the locomotive engineer would be prohibited from performing functions related to the PTC system that have the potential to distract the locomotive engineer from performance of other safety-critical duties. According to the public comments, that would make it impractical for certain freight railroads not to equip its locomotives with a second, interactive, display.

AAR says that FRA cannot point to any computer-related activities that could result in distraction of the engineer. The 2009 FRA report entitled Technology Implications of a Cognitive Task Analysis for Locomotive Engineers touches on this. For example, the report states: "Sources of new cognitive demands include constraints imposed by the PTC braking profile that require locomotive engineers to modify train handling strategies; increases in information and alerts provided by the in-cab displays that require locomotive engineers to focus more attention on in-

[16] The response to this kind of concern is typically that the PTC system will enforce, which was its purpose to start with. However, even vital electronics sometimes fail in other than a safe mode, and in that case the crew performance is relied upon to backstop the system (rather than the opposite)—assuming that the crew has information that it needs to do so. Further, if the engineer is distracted even for relatively few seconds the danger exists that the engineer will not take other necessary actions (sounding the horn at a crossing, monitoring the condition of the brake pipe and setting the train up for an upcoming slow order to avoid excessive in-train forces, etc.).

cab displays versus out the window, and requirements for extensive interaction with the PTC systems (e.g., to initialize it—to acknowledge messages and alerts) that impose new sources of workload." This suggests that, unless task sequencing is managed wisely, interaction with PTC can distract the engineer from looking outside the cab and attending to other duties important in train operation safety.

Over the years, FRA has conducted significant human factors research related to supervisory train control systems such as PTC. In the course of that research, it has been noted that the human-machine interface (HMI) should be configured to avoid task overload and to permit the locomotive engineer to attend to the safe movement of the train during all times when it is in motion. This may require responding to obstacles on the railroad ahead (e.g., vandalism, cars stored on grade crossings, unsecured equipment that has rolled out, personnel in the foul without prior notice to train crews), without regard to risk of collision with other trains. Further, FRA has noted from its experience with the initial freight implementations of PTC systems that having the second crew member, where applicable, directly interact with the PTC system may offer the best likelihood of its safe functioning. For instance, train consist information (number of locomotives and cars, tonnage, length of train) is provided in ETMS from the company's management information system). That information is essential to the braking computation onboard. But this is often the intended consist, and the actual consist may vary. Having the crew member responsible for the accuracy of the consist enter or confirm the consist in the PTC system will avoid one opportunity for error each time this is accomplished (which, in the case of a road switching assignment, may be several times during a duty tour).

The NPRM proposed, and the final rule requires, that the onboard apparatus be arranged so that each crew member assigned to perform duties in the locomotive cab could view a PTC display and execute any functions necessary to that crew member's duties. This provision does not require multiple screens, per se, nor does it require that more than one employee must be assigned to a crew. In fact, the proposed and final rules are technology neutral.

FRA is aware of multiple ways that paragraph (f) may be satisfied in the event multiple crew members are in the cab and need access to the information provided by the PTC system. Each alternative has its own advantages and difficulties. FRA is ultimately concerned that the crew members receive the same information displayed in the same manner.

For instance, there can be a single large display placed in a location within the cab making it accessible to all crew members in the cab. A single display (similar to traditional cab signals) could be used if sufficiently large to provide adequate resolution of details. If the railroad opts to use a PTC system that includes the added functionality of digital transmissions for these purposes, a single screen placed between the crew members may be appropriate.

A configuration may also include two fixed screens; one for the locomotive engineer and another for other crew members. In providing cost estimates for this rulemaking, the Class I railroads have assumed that this approach would be employed and that the display would be associated with an interactive terminal. FRA does not question the rationale in this manner and has approached costs estimates in the Regulatory Impact Analysis with this assumption.

The railroads have also discussed the possibility that, where the locomotive engineer may have his or her own fixed screen, the other crew members could make use of individual "heads-up" displays or personal handheld or portable wired and wireless devices with train control software, which could be set up as an interactive terminalThrough its Office of Research and Development, FRA has developed personal digital assistant (PDA) software for management of roadway worker authorities at a reasonable cost (at approximately one-quarter of the cost of a second dash-mounted display), and doing the same for a crew remote terminal should be just as practical. The vendor for the on-board portion of the ITC system already provides a router port, and routers are inexpensive. FRA assumes that there would be some additional costs related to replacement of misplaced or damaged devices and changing of batteries, but those costs should be reasonable. Under paragraph (f), hand-held or portable devices could be implemented and would have the same advantages as a fixed terminal. FRA does not require that the display be permanently affixed to the locomotive. The advantage of this approach would be a lesser initial cost, likely about one-fourth of the fixed terminal. Disadvantages include logistics of handling (loss, damage).

The major freight railroads point to passenger service as evidence that a "second display" is not required, but their arguments are inapposite. Crew responsibilities and interactions on passenger trains are historically different than is the case with freight crews, and thus crew resource management will not be undercut by use of a single display. For instance, in the case of a passenger train with a single locomotive engineer, the engineer will have the opportunity to initialize the system at the point of departure by making a relatively easy selection for class of train (if this is not done automatically). Moreover, unlike in freight operations, crew members for passenger operations do not need to enter or confirm detailed consist information for a heavy train that may have a wide variety of loaded and empty cars. If it is necessary for the locomotive engineer to take a mandatory directive through the PTC terminal, that can be done with the train stopped at a passenger station, as is the case today using the voice radio. Passenger railroads will almost certainly elect to use vital on-board processing, so the relative chance of an on-board computer error will be less.

For all of the systems proposed thus far, crewmembers must actively review and acknowledge mandatory directives in order for the system to provide the required level of safety. Where mandatory directives are transmitted by voice over the radio, which is the current practice for freight railroads, the conductor would typically be able to copy and acknowledge the transmission while the train is in motion. Passenger train engineers would have to be stopped (e.g., at a station) in order to copy and acknowledge the mandatory directive. See 49 CFR § 220.61(b)(2).
FRA is aware of three ways to receive, safely review, and acknowledge mandatory directives. First, the engineer could receive, review, and acknowledge authorities while the train is stopped. Second, the conductor could receive, review, and acknowledge voice transmissions of mandatory directives, whether or not the train is moving. Third, the conductor could receive, review, and acknowledge authorities through a device which combines display and data entry capabilities, whether or not the train is moving. The first option is likely how passenger railroads will comply with the requirements. Such railroads have only one crewmember in most cabs. This is likely not to be extremely burdensome on most passenger trains, as the engineer can receive, review, and acknowledge mandatory directives at passenger station stops. Thus, FRA is not being illogical, as AAR asserts, by permitting passenger operations with a single cab occupant. What would be illogical would be to require a second display where only one crewmember is present. Freight

locomotives with only one crewmember present would also be likely to use the first option, although the cab may be equipped with a second display. The second option would only require a display be within a conductor's view, but would be much lower cost. The third option, which FRA believes may be the norm for freight locomotives, may require the aforementioned second fixed screen, heads-up display, or handheld or portable device... FRA does not believe it would be practical for one terminal to serve both crewmembers if both may be required to enter or access data.

It should be noted that employing a fourth option, implied in railroad testimony, would be problematic on many fronts. That option would presumably involve a single display in front of the locomotive engineer. The train would receive electronic authorities exclusively through that device, and the engineer would acknowledge receipt using a simple procedure (e.g., pressing a single soft key) that was designed to hasten the task and limit distraction. The problem with such a procedure is that (i) there is no assurance that the engineer would understand what was being received, (ii) there is little chance that the engineer would identify any authority or slow order that was not appropriate to the situation, and (iii) there would be no reasonable way to convey the mandatory directive to the other crew member without stopping the train and copying it off the screen. This would be a perfect prescription for exclusive reliance on technology, which is ill advised and which the railroads claim will not be done (i.e., these are said to be "overlay" systems that cannot detract from the underlying methods of operation).

Again, the railroads are perhaps correct that safety might still be improved under this fourth option, at least as to the operations under PTC control, but that is not the question here. The question is whether technology will be employed that primarily protects against human error on board, or whether technology will be employed that that protects most of the time but induces human error on other occasions. Every day in the United States there are thousands of train starts and hundreds of thousands of opportunities for human error in train operations. Yet well-trained crews rise to these challenges, and as a result each year there are approximately 50 to 60 train collisions on the main lines, a small number of overspeed derailments and work zone violations, and a handful of movements through misaligned main track switches. Accordingly, a relatively small number of wrong-side errors in the operation of the PTC system accompanied by any diminishing of vigilance on the part of train crew members could easily cause results from PTC implementation to fall short of the risk reduction identified in FRA's analysis. With time and refinement of technology and databases, there may be significant adjustments that can be made in current operating rules and procedures. But existing PTC technology for the general freight system has not yet been proven at that level, and it will be some years before that will be the case. In the meantime, it will be crucial that informed and well coordinated crews maintain engagement in the management of mandatory directives and compliance with wayside or cab-displayed signal indications.

Accordingly, FRA remains convinced that each crew member should have access to, and engagement with, information and requirements pertinent to the operations for which they are responsible. This third option, combined with electronic transmission of mandatory directives, would pay for itself in a very short time. Assuming that a train has to be stopped twice each day for the engineer to acknowledge a directive, and that such a stop results in a cost of at least, and probably a lot more than, $80 to account for additional braking and trip time as well as missed opportunity for meets and passes, the cost of implementing this option would surpass the cost of installing a second terminal in just 50 days of service as the controlling locomotive. Assuming the locomotive is in the lead one-fourth of the time it is in service, the avoided cost of stopping would be $8,000, the cost of an additional terminal, in 200 days. In other words, the device will return its cost in much less than a year.

Of course, the business benefits of a second terminal are not as great if the railroad does not adopt electronic transmission of mandatory directives. However, FRA believes that railroads will adopt electronic transmission of mandatory directives as rapidly as possible. They would benefit from being able to give roadway workers much more rapid access to track, as well as by being able to reduce the dispatchers' workload. Further, the business benefits envisioned in Appendix A require more efficient dispatching, which would rely on electronic transmission of mandatory directives, as well as managerial directives related to train pacing and meet-pass planning.

The railroads have made no convincing argument that providing a second display would be harmful, as such. Rather, they argue that the cost is excessive in relation to any expected benefits. The AAR and several Class I freight railroads commented that the cost to install a second display in the locomotive would be approximately $8,000 per locomotive. According to AAR estimates, 29,461 locomotives would need to be equipped. This would translate into an initial installation cost of $235,688,000. However, AAR overestimated the number of locomotives, based on the document it cites. In that document, FRA estimated that 27,598 freight locomotives would be equipped with VTMS technology only, and an additional 100 freight locomotives would be equipped with both VTMS and ACSES technology, for a total of 27,698 locomotives, which, at a unit cost of $8,000 per terminal type display, implies a total cost of $221,584,000. AAR did not include the locomotives which would have both VTMS and ACSES installed, and included passenger locomotives that will likely not require additional hardware to meet the requirement due to the nature of their operations. FRA does not disagree with the AAR and railroad unit cost estimates, as long as what AAR refers to is the type of unit that has input capabilities. FRA recognizes that the cost is actually for an additional "terminal" versus simply a display and that it must be made rugged for the locomotive cab operating environment. The AAR and other railroads objecting to these requirements maintain that there will be little safety benefit to the requirements, and that the benefits would be far less than the costs. However, in the long run, FRA believes that the additional cost for installing a second terminal would be justified by the aforementioned business benefits as well as the safety assurance.

FRA is not altering the cost estimates for PTC from those in the analysis of the NPRM, because the costs of the second terminal were already reflected.

FRA notes that estimated cost of the second display will be about 4% of the total initial costs of PTC deployment. FRA has narrowly construed the PTC mandate to avoid separate monitoring of switches in signal territory, to avoid significant costs and potential delay related to following train collisions at low speed, and to provide generous exceptions where allowed by law (restricted speed in yards and terminals, passenger exceptions, Class II/III locomotives in limited operations on PTC lines, etc.)—actions that will save one or more billions of dollars during this initial implementation. If FRA believed a deviation from historic train control practice was warranted here to save 4% of the initial cost, we would happily provide it. We do not.

FRA believes that the PTC systems contemplated today will, at some point in the future, all accept electronic transmission of mandatory directives. The cost of providing a terminal to the second crewmember, where applicable, reflects that reality. Were railroads not planning to have conductors acknowledge mandatory directives, the railroad could provide the conductor with a screen without input devices, or a clearer view of the engineer's screen, which have a much lower unit cost.

FRA has placed in the docket of this rulemaking a document prepared by FRA's Office of Research and Development, referencing available human factors literature. Although FRA has addressed this issue from the point of view of whether the cost is justified, FRA wishes to emphasize that, at bottom, it is most crucial whether it would be possible to responsibly implement PTC on the national rail system without engaging the participation of each assigned crew member. We conclude that no such possibility has been demonstrated. Further, based upon FRA's knowledge of railroad operations and experience with oversight of existing and emerging train control technologies, FRA determines that it is essential for safety that each assigned crew member be provided the information and access to system inputs required to fulfill the crew member's respective duties.

AAR again raises the issue of single occupant cabs as an issue of "crew resource management" best left to the railroads. FRA maintains that these operators will only be authorized to receive, review, and acknowledge mandatory directives or similarly interact with the PTC systems when their trains are not in motion.

In the NPRM, FRA noted:

> [T]he principles of crew resource management and current crew briefing practices in the railroad industry require that all members of a functioning team (e.g., engineer, conductor, dispatcher, roadway worker in charge) have all relevant information available to facilitate constructive interactions and permit incipient errors to be caught and corrected. Retaining and reinforcing this level of cooperation will be particularly crucial during the early PTC implementation as errors in train consist information, errors generated in onboard processing, delays in delivery of safety warnings due to radio frequency congestion, and occasional errors in dispatching challenge the integrity of PTC systems even as the normal reliability of day-to-day functioning supports reductions in vigilance. Loss of crew cooperation could easily spill over to other functions, including switching operations and management of emergency situations.

Commenters generally made scant reference to this point. The AAR did include an attachment to its testimony captioned with reference to this point, but it begins with a summary task analysis to the effect that "the conductor is responsible for assisting in the operation." How the conductor will assist without a copy of the requisite orders available, when the duty to copy mandatory directives is eliminated (as the AAR assumes it will be), is left unexplained.

This is a "far cry" from section 402 of the RSIA08, which requires that FRA adopt regulations for the certification of train conductors. In FRA's experience as the agency responsible for oversight of railroad operating rules and practices, the conductor plays a key role in rail freight over-the-road operations by, inter alia, determining the train consist, ensuring compliance with hazardous materials placement and documentation requirement, calling or acknowledging signals, receiving mandatory directives, conducting frequent briefings with the locomotive engineer to ensure compliance with movement restrictions, and intervening through use of the conductor's brake valve if the engineer is unresponsive or incapacitated. A conductor may be disciplined with the locomotive engineer if a signal is violated or if a slow order or other mandatory directive is disobeyed, and this regularly occurs. The conductor plays the determinative role in switching operations, issuing the directions for operation of the locomotive(s) so as to accomplish safely the placement or pick-up of rail cars at customer locations, the making up and breaking up of trains, and the conduct of brake tests when mechanical personnel are not available.

Again, the major freight railroads have said that their PTC systems will "overlay" existing methods of operations. Those existing methods are defined in their books of rules, timetables and special instructions. The General Code of Operating rules, applicable to most railroad operations in the western U.S., provides at section 1.47 that "The conductor and engineer are responsible for the safety and protection of their train and observance of the rules." It further provides that "The conductor supervises the operation and administration of the train." "The conductor must remind the engineer that the train is approaching an area restricted by
:

- Limits of authority.
- Track warrant.
- Track bulletin.

or

- Radio speed restriction."

The rule continues: "To ensure the train is operated safely and rules are observed, all crew members must act responsibly to prevent accidents or rule violations. Crew members in the engine control compartment must communicate to each other any restrictions or other known conditions that affect the safety operation of their train sufficiently in advance of such condition to allow the engineer to take proper action." The rule further requires communication of signals and enjoins crew members to "take action to ensure safety, using the emergency brake valve to stop the train, if necessary."

The NORAC Operating Rules, applicable to a number of eastern U.S. railroads, provides at Rule 94 for general crew responsibilities similar to those quoted above. In addition, Rule 941 provides that "Conductors have general charge of the train to which they are assigned, and all persons employed thereon are subject to their instructions."

Each railroad is free, within the constraints of the Railway Labor Act as to staffing, and subject to oversight by FRA with respect to safety, to determine its operating rules and assignment of responsibilities to its personnel. Nevertheless, FRA remains concerned that railroad operating crews function as a team, discharging their responsibilities on the basis of adequate information and using their knowledge of the operating situation to identify safety concerns and resolve them. Within this framework, each crew member must remain able to respectfully and helpfully question a judgment by another crew member. This general approach is known as "crew resource management" (CRM), a concept perfected in aviation and urgently pressed on the railroad industry by the National Transportation Safety Board and the FRA. See NTSB Recommendation R-99-13 (July 29, 1999). Major railroads have included CRM in their training programs.

The fear with respect to a diminution of crew integrity and efficiency associated with asymmetrical distribution of current operational data is that, not only may opportunities be lost to correct errors within PTC operations, but also that the conductor's lack of engagement will transfer to operations on lines not equipped with PTC. Further, any reduction in ability to function as a team could transfer, as well, to road and yard switching operations. Should this occur, the price paid for PTC would include additional casualties and property damage where PTC is not available as a safety net. A substantial portion of the Class I freight network, and much of the switching and terminal railroad mileage over which Class I crews also operate, will not be equipped under the current mandate and perhaps not for many years. How crews are conditioned to function together will influence their behavior both within and outside of the PTC-equipped network. In summary, FRA believes that maintaining the involvement of all assigned crew members in operating and responding to the PTC system is necessary to achieve the desired risk reduction expected of PTC systems and is also necessary to avoid degrading crew performance outside of PTC territory and during switching operations.

NYSMTA requested clarification that in a multiple unit passenger train consist: (a) a second PTC display in every train operator compartment is not required inasmuch as only the train operator occupies the compartment, and; (b) the PTC operator displays in train operator compartments in a consist, other than those from which the train is operated from, are not to display PTC information while the train is en route. The MTA railroads have been repeatedly reassured on this point, and we are pleased to do so once again here.

As previously noted, on September 25, 2009, FRA entered into the docket to this rulemaking a compendium of human factors literature relevant to the HMI regulations and compiled by FRA's Office of Research and Development. AAR then submitted late-filed supplemental comments—which posted to the docket on October 20, 2009, approximately two months after the closing of the comment period and three weeks after FRA entered the compendium into the docket—addressing various portions of the compendium. FRA believes that this final rule already addresses each one of AAR's substantial concerns in its supplemental comments. AAR also states that it "has been deprived of the opportunity to consider its comments in a deliberative fashion." Supplemental Comment of the Association of American Railroads, Docket FRA-2008-0132-0055.1, at 3 (Oct. 20, 2009). However, contrary to AAR's suggestion, the Administrative Procedure Act (APA) does not require that FRA provide additional time to comment on the compendium. See, e.g., Credit Union Nat. Ass'n v. National Credit Union Admin., 57 F.Supp.2d 294, 302 (E.D. Va. 1995) (agency complied with the APA's notice and comment requirements, despite not disclosing certain data related to the rulemaking, because the agency had provided a reasonable opportunity to participate in the rulemaking process); see also Appalachian Power Co. v. E.P.A., 579 F.2d 846, 853 (4th Cir. 1978) (despite agency's failure to provide notice of certain data in advance of public hearings, interested parties were sufficiently advised of the scope and basis of the rulemaking to enable them to comment intelligently and meaningfully). Instead, the APA simply states that an agency must publish "the terms or substance of the proposed rule or a description of the subjects or issues involved." 5 U.S.C. § 553(b)(3). To meet the requirements of section 553, an agency "must provide sufficient factual detail and rationale for the rule to permit interested parties to comment meaningfully." Florida Power & Light Co. v. United States, 846 F.2d 765, 771 (D.C. Cir. 1988), cert. denied, 490 U.S. 1045 (1989).

FRA has provided that opportunity in this proceeding. The research recited in the compendium simply provided for the benefit of interested parties additional information that had previously been made public, FRA's views on the import of the research were aired during RSAC meetings and are expressed at various points in the NPRM, and the railroads obviously had sufficient time to prepare 16 pages of comments on the compendium itself. Clearly, the commenters were not prejudiced by the inclusion of the compendium in the docket.

Railroads would not adopt a second "terminal" with input capabilities, rather than just a simple, display-only screen, if there were no business benefits. FRA estimates that a simple display-only screen would cost $2,000, installed. The difference between the cost of a simple display and a terminal with entry capabilities is $6,000. FRA is not requiring data entry capabilities, but the railroads appear to be considering installation of interactive terminals with these capabilities. To the extent that railroads make such investments, they expect to get more in return than they spend. For the second display with input capability to be a net cost (i.e., for costs to exceed benefits) to the railroad, it would have to return a cash flow less than $6,000 per unit. That is a relatively narrow window. FRA believes that the railroads will adopt displays with entry capabilities to the extent that these will return a cash flow in excess of the cost of the additional cost.

The costs of a second screen where installed to comply with this section are included in the costs calculated below. FRA does not believe that it can meet the intent of Congress without providing the means to comply with core functions to every required crewmember. The costs and benefits of this section are included in the general analysis below.

4.22 Section 236.1031, Previously Approved PTC Systems

FRA recognizes that substantial effort has been voluntarily undertaken by the railroads to develop, test, and deploy Positive Train Control Systems prior to the passage of the RSIA of 2008, and that some of the PTC systems have accumulated a significant history of safe and reliable operations. In order to facilitate the ability of the railroads to leverage the results of PTC design, development, and implementation efforts that have been previously been approved or recognized by FRA prior to the adoption of this subpart, FRA is providing the expedited approval process of this section.

Under paragraph (a), each railroad that has a PTC system that may qualify for expedited treatment would have to submit a Request for Expedited Certification (REC) letter. Products that have not received approval under the subpart H, or have that have not been previously recognized by FRA, would be ineligible. The REC letter may be jointly submitted by PTC railroads and suppliers as long as there is at least one PTC railroad. A PTC system may qualify for expedited certification if it fulfills at least one of the descriptions provided in paragraphs (a)(1) through (a)(3). While these descriptions are objective in nature, FRA intends them to cover ETMS, ITCS, and ACSES, respectively. The versions or configurations recognized would depend upon the status at the time of the request.

Paragraph (a)(1) applies to systems that have been recognized or approved by FRA after submission of a PSP in accordance with subpart H. Subpart I generally reflects the same criteria required for a PSP under subpart H. Thus, FRA believes that most of the PTCDP and PTCSP requirements in subpart I can be fulfilled with the submission of the existing and approved PSP. However, FRA notes that the subject railroad will also need to submit the information required in a PTCDP and PTCSP that is not in the current PSP.

FRA also recognizes that certain PTC system may currently operate in revenue service with FRA approval through the issuance of a waiver or order. Paragraphs (a)(2) and (a)(3) intend to cover those systems.

If a PTC system complying with paragraph (a)(1) is provided expedited certification, the system plans should ultimately match the criteria required for each PTCDP and PTCSP. As previously noted, a railroad may seek to use a PTC system that has already received a Type Approval. To extend this benefit as it applies to previously used systems for which expedited certification is provided, paragraph (b) gives the Associate Administrator the ability to provide a Type Approval to systems receiving expedited certification in accordance with paragraph (a)(1).

FRA recognizes that certain systems eligible for expedited certification may not entirely comply with the subsequently issued statutory mandate. Accordingly, under paragraph (c), FRA is compelled to require that before any Type Approval or expedited certification may be provided, the PTC system must be shown to reliably execute the same functionalities of every other PTC system required by subpart I. Nothing in this abbreviated process should be construed as implying the automatic granting by FRA of a Type Approval or PTC System Certification. Each expedited request for a Type Approval or PTC System Certification must be submitted by the railroad under this abbreviated process and, as required under subpart I, must demonstrate that the system reliably enforces positive train separation and prevents overspeed derailments, incursions into roadway worker zones, and movements through misaligned switches.

Under paragraph (d), FRA encourages railroads, to the maximum extent possible, to use proven service history data to support their requests for Type Approval and PTC System Certification. While proven service history cannot be considered a complete replacement for an engineering analysis of the risks and mitigations associated with a PTC product, it provides great creditability for the accuracy of the engineering analysis. Testing and operation can only show the absence or mitigation of a particular failure mode, and FRA believes that there will always be some failure modes that may only be determined through analysis. Due to this inherent limitation associated with testing and operation, FRA also strongly encourages the railroads to also submit any available analysis or information.

Paragraph (e) requires that, to the extent that the PTC system proposed for implementation under this subpart is different in significant detail from the system previously approved or recognized, the changes shall be fully analyzed in the PTCDP or PTCSP as would be the case absent prior approval or recognition. FRA understands that the PTC product for which expedited Type Approval and PTC System Certification is sought may differ in terms of functionality or implementation from the PTC product previously approved or recognized by FRA. In such a case, the service history and analysis may not align directly with the new variant of the product. Similarly, the available service history and analysis associated with a PTC product may be inconclusive about the reliability of a particular function. It is because of these possible situations that FRA can not unequivocally promise that all requests for expedited Type Approval and PTC System Certification submitted by a railroad under this subpart will be automatically granted. FRA will, however, apply the available service history and analytical data as credible evidence to the maximum extent possible. FRA believes that this still greatly simplifies each railroad’s task in making its safety case, since the additional testing and analysis required need only address those areas for which credible evidence is insufficient. To reduce the overall level of financial resources and effort necessary to obtain sufficient credible evidence to support the claims being made for the safety performance of the product, FRA also encourages each railroad to share with other railroads a system’s service history and the results of any analysis, even in the case where the shared information does not fully support a particular railroad’s safety analysis.

Paragraph (f) defines terms used only in this section. “Approved” refers to approval of a PSP under subpart H. As this final rule was being prepared, only BNSF Railway’s ETMS Configuration I had been so approved, but other systems were under development. “Recognized” refers to official action permitting a system to be implemented for control of train operations under an order or waiver, after review of safety case documentation for the implementation. As this NPRM was being prepared, only ACSES I had been recognized under an order of particular applicability, and ACSES II was under review for potential approval. Only one system, the ITCS in place on Amtrak’s Michigan line, had been approved for unrestricted revenue service under waiver.

FRA was unable to fashion an outright “grandfathering” of equipment previously used in transit and foreign service. FRA does not have the same degree of direct access to the service history of these systems. Transit systems—except those that are connected to the general railroad system—are not directly regulated by FRA. FRA has had limited positive experience eliciting safety documentation from foreign authorities, particularly given the influence of national industrial policies.

However, FRA believes that, while complete exclusion may not be available in those circumstances, procedural simplification may be possible. FRA is considering a procedure under which the railroad and supplier could establish safety performance at the highest level of analysis for the particular product, relying in part on experience in the other service environments and showing why similar performance should be expected in the U.S. environment. Foreign signal suppliers should be in a good position to marshal service histories for these products and present them as part of the railroad's PTCSP. For any change, the applicant must provide additional information that will enable FRA to make an informed decision regarding the potential impact of the change on safety. This information must include, but is not limited to, the following: (1) a detailed description of the change; (2) a detailed description of the hardware and software impacted by the change; (3) a detailed description of any new functional data flows resulting from the change; (4) the results of the analysis used to verify that the change did not introduce any new safety risks or, if the change did introduce any new safety risks, a detailed description of the new safety risks and the associated risk mitigation actions taken; (5) the results of the tests used to verify and validate the correct functionality of the product after the change has been made; (6) a detailed description of any required modifications in the railroad training plan that are necessary for continued safe operation of the product after the change; and (7) a detailed description of any new test equipment and maintenance procedures required for the continued safe operation of the product.

In the same vein, paragraph (g) encourages re-use of safety case documentation previously reviewed, whether under subpart H or subpart I.

The costs and benefits associated with the requirements of this section are included in the general analysis below.

4.23 Section 236.1033, Communications and Security Requirements

Subpart I provides specific communications security requirements for PTC system messages. Section 236.1033 originated from the radio and communications task force within the PTC Working Group. The objectives of the requirements are to ensure data integrity and authentication for communications with and within a PTC system.

In data communications, "cleartext" is a message or data in a form that is immediately comprehensible to a human being without additional processing. In particular, it implies that this message is transferred or stored without cryptographic protection. It is related to, but not entirely equivalent to, the term "plaintext." Formally, plaintext is information that is fed as an input to a cryptographic process, while "ciphertext" is what comes out of that process. Plaintext might be compressed, encrypted, or otherwise manipulated before the cryptographic process is applied, so it is quite common to find plaintext that is not cleartext. Cleartext material is sometimes in plain text form, meaning a sequence of characters without formatting, but this is not strictly required as the sense is “no protection from snooping.” The security requirements are consistent with Department of Homeland Security (DHS) guidance for SCADA systems[17] and National Institute of Standards and Technology guidance. FRA has coordinated this final rule with DHS.

Paragraph (a) establishes the requirement for message integrity and authentication. Integrity is the assurance that data is consistent and correct. Generally speaking, in cryptography and information security, integrity refers to the validity of data. Integrity can be compromised through malicious altering—such as an attacker altering an account number in a bank transaction, or forgery of an identity document—or accidental altering—such as a transmission error, or a hard disk crash. A level of data integrity can be achieved by mechanisms such as parity bits and cyclic redundancy codes. Such techniques, however, are designed only to detect some proportion of accidental bit errors; they are powerless to thwart deliberate data manipulation by a determined adversary whose goal is to modify the content of the data for his or her own gain. To protect data against this sort of attack, cryptographic techniques are required. Thus, appropriate algorithms and keys must be employed and commonly understood between the entity wanting to provide data integrity and the entity wanting to be assured of data integrity

Authentication is the act of establishing or confirming something (or someone) as authentic. Various systems have been invented to provide a means for readers to reliably authenticate the sender. In any event, the communication must be properly protected; otherwise, an eavesdropper can simply copy the relevant data and later replay it, thereby successfully masquerading as the original, legitimate entity.

Sender authentication typically finds application in two primary contexts. Entity identification serves simply to identify the specific entity involved, essentially in isolation from any other activity that the entity might want to perform. The second context is data origin identification, which identifies a specific entity as the source or origin of a given piece of data. This is not entity identification in isolation, nor is it entity identification for the explicit purpose of enabling some other activity. Rather, this is identification with the intent of statically and irrevocably binding the identified entity to some particular data, regardless of any subsequent activities in which the entity might engage. Cryptographically based signatures provide nearly irrefutable evidence that can be used subsequently to prove to a third party that this entity did originate—or at least possess—the data.

Paragraph (b)(1) requires that cryptographic algorithms and keys used to establish integrity and authenticity be approved by either the National Institute of Standards or a similar standards organization acceptable to FRA. As a practical matter, cryptographic algorithms can be believed secure by competent, experienced, practicing cryptographers. This requires that the algorithms be publicly known and have been seriously studied by working cryptographers. Algorithms that

[17] Supervisory Control and Data Acquisition systems govern industrial processes, such as management of a power grid, control of a water treatment plant, etc. PTC systems are a subset of SCADA systems.

have been approved by NIST (or similar standards bodies) can be assured of being both publicly known and seriously studied.

Paragraph (b)(2) allows the use of either manual or automated means to distribute keys. Key distribution is the most important component in secure transmissions. The general key distribution problem refers to the task of distributing keys between communicating parties to provide the required security properties. Frequent key changes are usually desirable to limit the amount of data compromised if an attacker learns the key. Therefore, the strength of any cryptographic system results with the key distribution technique, a term that refers to the means of delivering a key to two parties that wish to exchange data without allowing others to see the key. Key distribution can be achieved in a number of ways. There are various combinations by which a key can be selected manually or in automation amongst one or multiple parties.

Paragraph (b)(3) establishes the conditions under which cryptographic keys must be revoked.

Paragraph (b)(3)(i) addresses the situation when a key has actually been found to have been compromised and when the possibility of key compromise exists. Cryptographic algorithms are part of the foundations of the security house, and any house with weak foundations will collapse. Adequate procedures should be foreseen to take an algorithm out of service or to upgrade an algorithm which has been used beyond its lifetime

Paragraph (d) addresses physical protection as applied to cryptographic equipment. Compliance does not necessitate locking devices within mechanical safes or enclosing their electronics within thick steel or concrete shields (i.e. making them tamper-proof). Compliance does, however, involve using sound design practices to construct a system capable of attack detection by a comprehensive range of sensors (i.e. tamper resistant). The level of physical security suggested should be such that unauthorized attempts at access or use will either be unsuccessful or will have a high probability of being detected during or after the event. Additionally, the cryptographic equipment should be prominently situated in operation so that its condition (outward appearance, indicators, controls, etc.) is easily visible to minimize the possibility of undetected penetration. In any system containing detection and destruction methods as described here, there is naturally a cost penalty for providing very high levels of tamper resistance, due to construction and test requirements by the manufacturer. It is naturally important to analyze the risks of key disclosure against cost of protection and specify a suitable implementation.

Confidentiality has been defined by the International Organization for Standardization (ISO) as "ensuring that information is accessible only to those authorized to have access." Confidentiality, integrity, and authentication all rely on the same basic cryptographic primitives—algorithms with basic cryptographic properties—and their relationship to other cryptographic problems. These primitives provide fundamental properties, which guarantee one or more of the high-level security properties. In paragraph (e)(1), FRA makes it clear that while providing for confidentiality of message data is not a regulatory requirement, if confidentiality is elected to be implemented by a railroad, that the same protection mechanisms applicable to the cryptographic primitives that support integrity and authentication must also be provided for the cryptographic primitives that support confidentiality.

It is only the difficulty of obtaining the key that determines security of the system, provided that there is no analytic attack (i.e., a "structural weakness" in the algorithms or protocols used), and assuming that the key is not otherwise available (such as via theft, extortion, or compromise of computer systems). A key should therefore be large enough that a brute force attack (possible against any encryption algorithm) is infeasible, whereas the attack would take too long to execute.

Under information theory, to achieve perfect secrecy, it is necessary for the key length to be at least as large as the message to be transmitted and only used once (this algorithm is called the one-time pad). In light of this, and the practical difficulty of managing such long keys, modern cryptographic practice has discarded the notion of perfect secrecy as a requirement for encryption, and instead focuses on computational security. Under this definition, the computational requirements of breaking an encrypted text must be infeasible for an attacker. Paragraph (e)(2) requires that in the event that a railroad elects to implement confidentiality, the chosen key length should provide the appropriate level of computational complexity to protect the information being protected, and that this information be included in the PTCSP. Both academic and private organizations provide recommendations and mathematical formulas to approximate the minimum key size requirement for security based on mathematic attacks; they generally do not take algorithmic attacks, hardware flaws, or other such issues into account. Paragraph (e)(2) has been revised in the final rule to correct an erroneous cross-reference to the security requirements set forth in § 236.1013(a)(7).

Key management—the process of handling and controlling cryptographic keys and associated material during their life cycle in a cryptographic system—includes ordering, generating, distributing, storing, loading, escrowing, archiving, auditing, and destroying the different types of material. Paragraph (e) requires that cleartext stored cryptographic keys be protected from unauthorized disclosure, modification, or substitution. During key management, however, it may be necessary to validate the accuracy of the key being entered, especially in cases where the key management process is being done manually. During the key entry process, keys not encrypted to protect against disclosures may be temporarily displayed to allow visual verification. However, if the key has been encrypted to protect against disclosure, then the cleartext version of the key may not be displayed. This does not, however, preclude the display of the encrypted version of the key.

In paragraph (f), FRA requires that each railroad implement a service restoration and mitigation plan to address restoral of communications services in the event of their loss or disruption and to make this plan available to FRA. Loss of communications services reduces or eliminates the effectiveness of a PTC system and FRA requires that these critical safety systems, once implemented, are restored to operation as soon as practical. FRA believes that the restoration plan must include testing and validating the plan, communicating the plan, and validating backup and restoration operations.

To ensure that these or any other procedures work in the railroads operational environment, the railroad must validate each procedure intended for implementation. The backup and restoration plan should clearly describe who is to implement procedures and how they are to do it. The primary information to be communicated includes: the team or person (specified as an individual or a role) that is responsible for determining when restoration of service is required and the procedures to be used to restore service, as well as the team or person responsible for implementing procedures for each restoration scenario; the criteria for determining which restoration procedures are most appropriate for a specific situation; the time estimates for restoration of service in each restoration scenario; the restoration procedures to be used, including the tools required to complete each procedure; and the information required to restore data and settings.

Finally, paragraph (g) makes clear that railroads are permitted to implement more restrictive security requirements provided the requirements do not adversely impact the interoperability. FRA has received no comments on this section and has adopted it as proposed.

FRA does not believe that a system which does not have secure communications meets the intent of Congress in RSIA08. The costs and benefits of this section are included in the general analysis below.

4.24 Section 236.1035, Field Testing Requirements

Initial field or subsequent regression testing of a PTC product on the general rail system is often required before the product has been certified in order to obtain data to support the safety case presented in the PTCSP. To ensure the safety of the public and train crews, prior FRA approval is required to conduct test operations on the general rail system. This paragraph provides an alternative to the waiver process when only part 236 regulations are involved. When regulations concerning track safety grade crossing safety or when operational rules are involved, however, this process would not be available. Such testing may also implicate other safety issues, including adequacy of warning at highway-rail crossings (including part 234 compliance), qualification of passenger equipment (part 238), sufficiency of the track structure to support higher speeds or unbalance, and a variety of other safety issues, not all of which can be anticipated in any special approval procedure. Approval under this part for testing does not grant relief from other parts of these and the railroads must still apply for relief the non-236 regulations under the discrete special approval sections of those regulations, under provisions of part 211 related to waivers, or both.

The information required for this filing is described in paragraphs 236.1035(a)(1)–(a)(7). This information is necessary in order for FRA to make informed decisions regarding the safety of testing operations. FRA would prefer that the informational filings to test under this part be accompanied by any requests for relief from non 236 regulations so that they may be considered as a whole.

Paragraph (b) provides notification that FRA may, based on the results of the review of the information provided in (a) and in order to provide additional oversight to ensure the safety of rail operations, impose special conditions on the execution of the testing, up to, and including the appointment of an FRA test monitor to provide additional oversight to ensure the safety of rail operations. When a test monitor is appointed, they have the authority to stop testing if the testing is unsafe, require additional tests as necessary to demonstrate the safe operation of the system, or have tests rerun when the results are in question.

Paragraph (c) reemphasizes the earlier discussion that either temporary or permanent requests for relief for other than requirements of part 236 must be submitted in accordance with the processes specified by part 211.

The costs and benefits associated with this section are included in the general analysis below.

4.25 Introduction to Sections 236.1037 through 236.1049

In subpart H, §§ 236.917 through 236.929 contain various requirements that involve PSPs. FRA believes that these requirements should apply equally to PTC systems governed by subpart I. FRA has included §§ 236.1037 to 236.1049 to inform interested parties how these elements would apply. FRA intends that the meanings of those sections in subpart H, as described in the preamble to its proposed and final rules, would also apply equally in the context of the final rule. While FRA has considered amending these sections in subpart H to incorporate references to subpart I, FRA believes such an attempt and its results would be cumbersome and awkward. Thus, FRA has included the provisions in subpart I for clarity.

The Rail Labor Organizations have expressed support for the training and qualification provisions in §§ 236.1041, 236.1045, 236.1047, and 236.1049 and support an expansion of PTC personnel training requirements, as necessary, based upon experience gained and any training deficiencies identified during operations of these systems. The RLO states that training on the PTC system is essential for all employees who will interface with this technology. While the RLO supports the requirement that employees must maintain the skill level necessary to safety operate trains, they urge FRA to consider that the "4 hour work period" of manual operation of a train should be conducted not less often than once in any given tour of duty. Considering that the maximum workday (except in extreme emergencies) is 12 hours, the locomotive engineer will then be manually operating the train at least 33% of the time. FRA has considered this suggestion for a change in the approach from subpart H. However, FRA believes that this is an issue that should be more specifically addressed in the PTCSP for the system, should automatic operation ever be proposed.

4.26 Section 236.1037, Records Retention

Retention of PTC related records provides documentary proof that the system is performing as intended, and that the appropriate training has occurred. Accordingly under (a) FRA is requiring each railroad, and each vendor if appropriate, a repository of records documenting actions taken by the railroads   The location of this repository is at the discretion at the railroad, and my be either distributed or centralized as long as FRA or FRA designated state inspectors have access during normal business hours. All documents and records must be available for FRA inspection and copying.

FRA appreciates the expense associated with the creation, transmission, and storage of documents, and therefore is willing to accept either paper copies, or electronic copies maintained in accordance with a plan approved under § 236.110, which authorizes electronic recordkeeping under part 236 generally. FRA would expect to make conforming amendments to § 236.110 paralleling paragraph (c) of that section, which currently govern recordkeeping under subpart H. Comment is requested on the extent to which these provisions have proved successful or require revision. The minimum sets of documents that must be maintained are:

A. Any type approval, its associated PTDP if appropriate, variances from the PTCDP if approved, and the PTCSP that the railroad holds.
B. Adequate documentation that to demonstrate the PTCDP and PTCSP meets the safety requirements of this subpart including the risk assessment. The risk assessment must contain all initial assumptions for the system that are listed in paragraph (i) of Appendix B—Risk Assessment Criteria.
C. The current (master) operations and maintenance manual as described in 236.1039
D. The training and testing records which designate persons who are qualified
E. All implementation, maintenance, inspection, and testing and regression testing records as described in Paragraph (2) is intended to make it clear that the requirements not only apply to the railroads, but also to the railroads vendors.

The retention period for these records begins when the railroad places the PTC system in service. After the product is placed in service, paragraph (b) requires the railroad to maintain a database of safety-relevant hazards which occur or are discovered on the product. This database information shall be available for inspection and replication by FRA and FRA certified state inspectors, during normal business hours. Paragraph (b) also provides the procedure which must be followed if the frequency of occurrence for a safety relevant hazard exceeds the threshold value provided in its PTCDP /PTCPP. This procedure involves taking immediate steps to reduce the frequency of the hazard and report the hazard occurrence to FRA. FRA realizes the scope and impact could vary dramatically. In some cases, an adequate response could be completed within days. In other cases the total response could take years, even with prompt, deliberate action. If either case, prompt notification to FRA of the problem is required (b)(1). The reports may be made to FRA by mail, facsimile, e-mail, or hand delivery.

These reporting requirements are not intended to replace, or excuse from compliance, FRA reporting requirements under part 233. In the case of a false proceed signal indication; FRA would not expect the railroad to wait for the frequency of such occurrences to exceed the threshold reporting level assigned in the hazard log. Rather, current § 233.7 requires all such instances to be reported.

FRA believes the 15 day reporting period especially in light of electronic means of delivery, is adequate. FRA currently allows faxing, emailing, or hand delivery. Documents that are hand delivered to FRA must not be enclosed in an envelope, as all envelopes are required to be routed through the DOT mail room.

FRA believes that the records required in this section are a key to complying with a performance standard. Were FRA to impose a specification standard it could dispense with some of the recordkeeping requirements, but the burden of such a specification standard would far exceed the burden of recordkeeping. The costs and benefits of this section are included in the general analysis below.

4.27 Section 236.1039, Operations and Maintenance Manual

This section, which is modeled on the analogous section of subpart H, requires that each railroad develop a manual covering the requirements for the installation, periodic maintenance and testing, modification, and repair for its PTC systems. FRA encourages the use of an electronic format as an appropriate medium for such a manual. Electronic copies of the manual should be maintained in the same manner as other electronic records, and the manual should be included in the railroad's configuration management plan (with the master copy and dated amendments carefully maintained so that the status of instructions to the field as of any given date can be readily determined).

All specified documentation contained in the PTCDP and PTCSP that are necessary for the installation, repair, modification and testing of a product must be placed in an Operations and Maintenance Manual for that product and be made available to both persons required to perform such tasks and to FRA.

Paragraph (b) requires that plans necessary for proper maintenance and testing of products be correct, legible, and available where such systems are deployed or maintained. The paragraph also requires that plans identify the current version of software installed, revisions, and revision dates.

Paragraph (c) requires that the hardware, firmware, and software versions be recorded in the Operations and Maintenance manual in accordance with the configuration management requirements specified in the PTCDP and PTCSP.

Paragraph (d) requires that safety critical components contained in PTC systems, including spare equipment, be identified, replaced, handled, and repaired in accordance with the configuration management requirements specified in the PTCSP.

Finally, paragraph (e) requires that a railroad officer be appointed to be responsible for coordination of the restoration plan required under 236.1033(f) for communications outages.

FRA believes that the manuals required in this section are a key to complying with a performance standard. Were FRA to impose a specification standard it could dispense with some of the manual requirements, but the burden of the operations and maintenance required by such a specification standard would likely exceed the burden of those under the manuals. The costs and benefits of this section are included in the general analysis below.

4.28 Section 236.1041, Training and Qualification Program (General)

The training provisions of the final rule closely track the analogous sections of subpart H. This general section sets forth the general requirements of an employer's training and qualification programs related to PTC systems. This section requires the PTCP to provide a description of the specific training necessary to ensure the safe installation, implementation, operation, maintenance, repair, inspection, testing, and modification of the product. This section does not restrict the employer from adopting additional or more stringent training requirements. The training program takes on particular importance with respect to PTC systems, because the railroad industry's workforce generally does not have thorough knowledge of the operation of such equipment and appropriate practices for its operation and maintenance. FRA believes employee training and qualification on how to properly and safely perform assigned duties are crucial to maintaining safe railroad equipment and a safe workplace.

FRA believes that many benefits will be gained from the railroads' investment in a comprehensive training program. The quality of inspections will improve, which will result in fewer instances of defective equipment in revenue service and increased operational safety. Under an effective training program equipment conditions that require maintenance attention are more likely to be discovered and repairs can be completed safely and efficiently before catastrophic failure, trouble-shooting will more likely take less time; and maintenance will more likely be completed correctly the first time, resulting in increased safety and decreased costs.

The program will provide training for persons whose duties include inspecting, testing, maintaining or repairing elements of the PTC system including central office, wayside, or onboard subsystems. In addition, it will include training required for personnel dispatching and operating trains in territory where PTC is in use and for roadway workers whose duties require knowledge and understanding of operating rules. Finally, it will include supervisors of the foregoing persons.

Paragraph (a) establishes the general requirement for when a training program is necessary and who must be trained. Training programs must meet the minimum requirements listed in §§ 236.1043 through 236.1049 as appropriate, and any more stringent requirements in the PTCSP for the product. FRA wants to clarify the intent of this section. Railroads are responsible for training their own employees. Contractors, including suppliers whose employees are performing the duties described in this section, are also responsible for training their own employees. FRA is not requiring that railroads provide training for contractor employees. FRA wishes to make it very clear employers are responsible for having their employees who perform work covered by this section trained and qualified. If FRA finds untrained contractors performing work that requires training, both the contractor and railroad may potentially be subject to civil penalty enforcement activity. Railroads should be seeking assurance that contractors have training programs that comply with this section and that the contractors are utilizing trained and qualified personnel to perform work on the PTC system.

If the railroad has placed a clear contractual responsibility on the provider of services to train personnel and maintain appropriate records, FRA would normally proceed first against the contractor. In any event, FRA would expect to see prompt corrective action.

Paragraph (b) establishes the general requirement that the persons cited in paragraph (a) must be trained to the appropriate degree to ensure that they have the necessary knowledge and skills to effectively complete their duties related to operation and maintenance of the PTC system.

No railroad could adopt PTC without sufficient training. The costs and benefits of this section are included in the general analysis below.

4.29 Section 236.1043, Task Analysis and Basic Requirements

This section sets forth specific parameters for training railroad employees and contractor employees to assure they have the necessary knowledge and skills to effectively complete their duties as related to the safe operation and maintenance of PTC systems. Employers, whether railroads or contractors, are responsible for complying with this section. This section explains that the functions performed by an individual will dictate what type of training that person should receive related to the PTC system. For example, a person that operates a train would not require training on how to inspect, test, and maintain the system equipment unless the person were also assigned to perform those tasks.

The intent of this section is to ensure that employees, who work with products covered by this rule, including contractors, know how to keep them operating safely. The rule grants the employer flexibility to focus and provide training that is needed in order to complete a specific task. However, the rule is designed to prevent the employer from using under-trained and unqualified people to perform safety critical maintenance on a PTC system.

This section describes that the training and qualification programs specified in §236.1041 must include a minimum group of identified requirements. These minimum requirements will be described in the PTCSP. This required training is for railroad employees and contractor employees to assure they have the necessary knowledge and skills to effectively complete their duties related to the PTC system,

Paragraphs (a)(2) and (a)(3) provide that the employer will identify inspection, testing, maintenance, repairing, dispatching, and operating tasks for the PTC system and develop written procedures for performance of those tasks. Paragraph (a)(4) requires that the employer identify additional knowledge and skills above those required for basic job performance necessary to perform each task. The point here is that work situations often present unexpected challenges, and employees who understand the context within which the job is to be done will be better able to respond with actions that preserve safety. Further, the specific requirements of the job will be better understood; and requirements that are better understood are more likely to be adhered to. An example is the so-called ''gap training'' for employees who are expected to work on the electronics of the PTC system. Employees need to understand in at least a general way how their duties fit into the larger program for maintaining safety on a railroad. If they lack a basic understanding of the functioning of the systems they are working on, they are more likely to make a mistake in a situation where instructions are ambiguous and where the unusual nature of the problem prompts discovery of a void in the instruction set. Well informed employees will be less likely to free-lance trouble shooting; and, incidentally, they should also be of greater value in assisting with trouble shooting (an economic benefit which should, by itself, offset the some of the cost of this requirement).

Paragraph (a)(5) requires that the employer develop a training curriculum which includes either classroom, hands-on, or other formally-structured training designed to impart the knowledge and skills necessary to perform each task. The training curriculum may be designed by the railroad in consultation with the manufacturer of the product, utilizing training materials and manuals prepared by the vendor.

Paragraph (a)(6) establishes the requirement that all persons subject to training requirements and their direct supervisors must successfully complete the training curriculum and pass an examination for the tasks for which they are responsible. For example, a person who operates a train would not require training on how to inspect, test, or maintain the equipment unless the person were assigned to also perform those tasks. Generally, appropriate training must be given to each of these employees prior to task assignment; however, an employee may be allowed to perform a task for which that person has not received the appropriate training only if the employees do so under the direct, on-site supervision of a qualified person. The "direct supervisor" is intended to mean the immediate, first level supervisor to whom the employee reports.

The training of direct supervisors would depend upon an analysis of the supervisor's job, including his or her specific tasks, and not merely position on the organizational chart. The identification of training goals and the task analysis required in paragraphs (a)(1) and (2) includes management goals and tasks. Managers and supervisors must be trained to carry out the functions their duties require. If a direct supervisor is in a position where he or she may have to fulfill the responsibilities or duties of a subordinate, he or she must have the requisite knowledge and training to do so. If, however, a manager or supervisor will likely never need to fulfill the duties of a subordinate, and that person is not expected to provide technical oversight for certain functions, he or she may not need to be trained on those functions. This requirement is designed to ensure that supervisors have the requisite knowledge, training, and familiarity with the duties of their subordinates such that they can competently supervise the workforce.

Paragraph (a)(7) requires that periodic refresher training be conducted at intervals specified in the PTCSP. This periodic training must include either classroom, hands-on, computer-based training, or other formally-structured training in order that railroad employees and contractor employees maintain the knowledge and skills necessary to safely perform their assigned tasks.

Paragraph (a)(8) establishes a requirement to compare actual and desired success rates for the examination. The objective of this requirement is twofold. The first is to determine if the training program materials and curriculum are imparting the specific skills, knowledge, and abilities to accomplish the stated goals of the training program. The second is to determine if the stated goals of the training program reflect the correct, and current, products and operations.

Over time, changes in railroad products and operations may result in differences between the original defined goals and tasks from the original PTCDP and PTCSP. Similarly, over time the effectiveness of the training process may change as a result of instructional methods and student skill levels. Changes in training may be necessary as a result. Ongoing, regular verification of the results of the training process is required to ensure that the training program materials and curriculum are relevant, the learning objectives are being met, and the necessary skills, knowledge and ability are actually being imparted. Without regular feedback, verification and validation (and if necessary, adjustments, to ensure the necessary relevancy and effectiveness) cannot occur.

Paragraph (b) provides that the employers must maintain records which designate persons who are qualified under this section. These records must be kept until new designations are recorded or for at least one year after such person(s) leave applicable service, and must be available for FRA inspection and copying. A railroad's contractor must maintain records on contractor employees who perform work covered by this section. FRA expects to have access to the training records of contractor employees whose work functions are covered by the training requirements of this section. If FRA cannot get access to such records, the railroad and contractor or supplier may be subject to civil penalty enforcement activity.

No training program is likely to achieve its goals without analyzing the tasks for which training is needed, and then training on those tasks. Most proposed PTC systems are vulnerable to overreliance by crewmembers compromising the additional safety provided, so this is a key part of any performance standard.

The costs and benefits of this section are included in the general analysis below.

4.30 Section 236.1045, Training Specific to Control Office Personnel

This section explains the training that must be provided to employees responsible for issuing or communicating mandatory directives. This training must include instructions concerning the interface between computer-aided dispatching systems and the PTC system as applicable to the safe movement of trains and other on-track equipment. In addition, the training must include operating rules that pertain to the train control system, including the provision for moving unequipped trains and trains on which the train control system has failed or been cut out en route.
This section sets forth the requirements for instructions on control of trains and other on-track equipment when a train control system fails. It also includes periodic practical exercises or simulations and operational testing under part 217 to assure that personnel are capable of providing for safe operations under alternative operation methods.

The costs and benefits of this section are included in the general analysis below.

4.31 Section 236.1047, Training Specific to Locomotive Engineers and Other Operating Personnel

This section specifies minimum training requirements for locomotive engineers, conductors, and other operating personnel who interact with PTC systems. "Other operating personnel" is intended to refer to onboard train and engine crew members other than the engineer or conductor. Paragraph (a) requires that the training contain familiarization with the PTC equipment and the functioning of that equipment along with its relationship to other onboard systems under that person's control. The training program must cover all notifications by the system (i.e. onboard displays) and actions or responses to such notifications required by onboard personnel, as well as how each action or response ensures proper operation of the system and safe operation of the train.

Paragraph (b) states that with respect to certified locomotive engineers, the training requirements of this section must be integrated into the training requirements of 49 CFR part 240.

Paragraph (c) addresses requirements for use of PTC system to effect full automatic operation. FRA acknowledges that this rule is not designed to address all of the various safety issues which accompany full automatic operation (although it by no means discourages their development and implementation); however, insofar as skills maintenance of the operator is concerned, the rule offers the standards in this paragraph.

Paragraph (c)(1) establishes the requirement that the PTCDP and PTCSP must identify all safety hazards to be mitigated by the locomotive engineer. Paragraph (c)(2) concerns required areas of skills maintenance training. Paragraph (d) requires similar training for conductors as provided for engineers.

FRA believes that there is no one curriculum across the board that will generally satisfy the locomotive engineer and conductor training requirements. As with the general training requirements, the requisite task analysis will be specific to the functions of the system or systems of each railroad. Accordingly, the resulting training curriculum will correspond with the tasks or functions necessary for that particular system.

The costs and benefits of this section are included in the general analysis below.

4.32 Section 236.1049, Training Specific to Roadway Workers

This section requires the railroad to incorporate appropriate training in the program of instruction required under part 214, subpart C, Roadway Worker Protection. This training is designed to provide instruction for workers who obtain protection for roadway work groups or themselves and will specifically include instruction to ensure an understanding of the role of a processor-based train control system in establishing protection for workers and their equipment, whether at a work zone or while moving on track between work locations. Also, this section requires that training include recognition of PTC control equipment on the wayside and how to avoid interference with its proper functioning.

The required task analysis will tailor each program to the needs of the particular system to which it applies. FRA assumes that a good task analysis would include procedures and training on procedures for system failures. Roadway workers are uniquely situated out on the right-of-way are at risk of being struck by trains and on-track equipment. Given the potential for exposure to extreme peril, FRA believes specifying training and periodic drills on that training is worthwhile.

The costs and benefits of this section are included in the general analysis below.

4.33 Appendix B to Part 236 – Risk Assessment Criteria

FRA is modifying Appendix B to part 236 to enhance the language for risk assessment criteria in a light of experience gained during the initial stage of PTC system implementation under subpart H and to accommodate the requirements of subpart I regulating the use of mandatory PTC systems required by RSIA08. As modified, the Appendix B will incorporate new language in paragraphs from (a) through (h), as well as modifying some of the associated headings.

Paragraph (a) reflects the change in the required length of time over which the [system] risk must be computed. FRA replaces the requirement to assess risk for the system “over the life-cycle of 25 years or greater” with the requirement to assess risk “over the designed life-cycle of the product.” FRA believes that the new wording of this requirement puts it in correspondence with the final rule language that does not specify the length of a system life-cycle, and with the subpart H preamble language that leaves room for the new processor-based systems to have a shorter than 25 years life-cycle.

Paragraph (b) is reworded to clarify the intent of this requirement.

Paragraph (c) is modified and the heading of this paragraph is changed to identify better the main purpose of this requirement and to ensure its consistency with the associated requirements of sections 236.909 (c) and (d). FRA believes the previous text of this paragraph and its title did not fully support or clarify the main intent of subpart H to require that the total cost of hazardous events should be the risk measure for a full risk assessment and the MTTHE calculations for all hazardous events the risk measure for the abbreviated risk assessment.

The existing subpart H text asks for both the base case and the proposed case to be expressed in the same metrics. Paragraph (c) of this appendix, as written prior to the final rule, did not fully reflect FRA's intent that the same risk metric is to be used in the risk assessment for both the previous and current conditions (see 236.913 (g) (2) (vii). FRA believes that the revised title of this paragraph poses the right question and that the new formulation of this paragraph provides better guidance on how to perform risk assessment for previous and current conditions.

The text and the title of paragraph (d) have been modified to create a comprehensive and detailed list of system characteristics that must be included in the risk assessment for the proposed PTC systems subject to requirements of [both] subpart H and subpart I. FRA believes that the extended description of system characteristics better suits the requirements of Subpart H and especially subpart I related to risk assessment. For example, the revisions make it clear that the risk assessment must account not only for the total volume of traffic, but also for the type of transported freight materials (TIH, PIH), as well as for speeds for freight and passenger trains if part 236 places additional requirements for certain types of train control systems to be used at such speeds.

Paragraph (e) is also modified to clarify its intent and reflect industry's experience in risk assessment techniques gained during initial stage of PTC system implementation under subpart H. In the this paragraph FRA gives more specific guidance on how to derive the main risk characteristics, MTTHE, and what role reliability and availability parameters, such as MTTF or MTBF for different system components can play while assessing risk for vital and non-vital hardware/software components of the system. FRA emphasizes it is critical, that each railroad and its vendors include the software failure rates into risk assessments for the system. FRA also finds it necessary to advise railroads and their vendors to include reliability and availability characteristics, such as MTTF or MTBF into risk assessment in order to account for potential system exposure to hazards during system failures or malfunctioning, when the system operates in its fall back mode.

FRA believes that the modifications to this paragraph more accurately addresses the industry's need for clarity in interpretation and execution of final rule requirements related to risk assessment. . FRA received comments from HCRQ/CGI noting that the phrases "frequency of hazardous events" and "failure frequency", which were contained in paragraph (e) of the proposed rule, are equivalent. HCRQ/CGI therefore recommended that FRA revise the second sentence in paragraph (e) to read as follows: "The MTTHE is to be derived for both fail-safe and non-fail-safe subsystems or components." FRA agrees with this recommendation and has therefore revised the second sentence of paragraph (e) accordingly.

Several commenters questioned whether additional guidance on acceptable methods for calculating MTTHE values for processor-based subsystems and components can be given by

FRA. FRA believes it is inappropriate to provide this guidance in the text of the final rule, especially counting the fact that FRA is not to be involved in all aspects of the design and engineering associated with a product. Any guidance that FRA could provide would not reflect the level of understanding that the vendor(s) and system integrators of the product should have gained through out the design and implementation process that would enable them to specify, evaluate and determine such critical measures such as MTTF, MTBR, and MTTHE. There is a large body of publicly available work from the research and engineering community that addresses various perspectives on determination of appropriate methods of determining MTTHE and other related parameters. Upon receipt of the risk assessment documentation in the PTCSP, FRA will provide feedback on the appropriateness of a vendor or railroad selected methodology for determining MTTHE and the acceptability of the results of calculations based on that methodology with respect to regulatory acceptability. However FRA views the specification and determination of appropriate MTTHE and other design parameters as a fundamental responsibility of the system integrator or vendor that neither can nor should be abrogated.

FRA received comments on the last sentence in paragraph (f)(1) from HCRQ/CGI, in which HCRQ/CGI asserted that "permanent" faults would result in an MTTHE of zero. In addition, HCRQ/CGI asserted that "transient" by definition is something that comes and then goes away, which may never be detected. Thus, HCRQ/CGI questioned how one could determine the rate of its occurrence. In order to address these concerns, HCRQ/CGI recommended that FRA revise the last sentence in paragraph (f)(1) to read as follows: "The MTTHE calculation must consider the rates of failures caused by contributory faults accounting for the fault coverage of the integrated hardware/software subsystem or component, phased interval maintenance, and restoration of the detected failures."

In response to this comment FRA would like to reiterate that the main intent of the requirement specified in paragraph (f) (1) was to request that the statistics on subsystem or component failures available for MTTHE calculation must be used in its entirety. This means that all types of failures (faults) observed during subsystem or component operation should be accounted for, regardless of the types of failures by their appearance to the observer (permanent, transient or intermittent), and regardless of whether the failure was caused by the fault of the subsystem or component itself or by errors of the operating agent (human factor associated with operation, maintenance or restoration of the subsystem). FRA feels that replacing the enumerated in the original text types of faults "permanent, transient, and intermittent" with the term "contributory faults" will not assure that all types of faults will be accounted for. FRA also notes that the derivation of MTTHE for the operating system, subsystem or component for which the risk assessment is to be performed is a complex process which may require the use of Fault Tree Analysis or other relevant techniques. These techniques will use the probabilities of single point component failures identified for the system. This process cannot lead to MTTHE of zero value. Neither can this process result in MTTHE being equal infinity. The calculated probability of accidents (the inverse value of MTTHE) may be infinitely small to the extent that the safety requirement of this Part is met (i.e. during the entire life time of the system it is very unlikely for the accident to occur) but rarely will the probability of such events be zero in a practical world. Based on this reasoning FRA retains the text in paragraph (f)(1) unchanged.

Paragraph (f)(2) is modified to reflect FRA's "understanding"- that software failure analysis may not necessarily be based on MTTHE "Validation and Verification" processes and that MTTHE characteristic's cannot be easily obtained for the system software components. Therefore, the modification intends to outline the significance of detailed software fault/ failure analysis and software testing to demonstrate repeatable predictive results that all software defects are identified and corrected.

FRA received comments from HCRQ/CGI on paragraph (f)(2), in which HCRQ/CGI asserted that "proper" assessment is open to interpretation, while Real Time Operating System (RTOS) "evaluation" is possible. HCRQ/CGI also asserted that the assessment of device driver software would require the source code, which is usually proprietary. Thus, HCRQ/CGI recommended that the assessment should include Commercial Off-The-Shelf (COTS) software, if incorporated, other than the operating system. HCRQ/CGI asserted that FRA could make this change by revising the first sentence in paragraph (f)(2) to read as follows: "Software fault/failure analysis must be based on the assessment of the design and implementation of the application code, an evaluation of the operating/executive program and other COTS software components..."

HCRQ/CGI also commented that it is not possible to demonstrate that all software defects have been identified with a high degree of confidence. HCRQ/CGI quotes a famous statement made years ago (author unknown): "It is common in industry to find a piece of software, which has been subjected to a thorough and disciplined testing regime, has serious flaws." HCRQ/CGI asserted that it is not clear what "high degree of confidence" implies. Therefore, HCRQ/CGI recommended that the last sentence in paragraph (e)(2) be revised to read as follows: "The software assessment process must demonstrate, through repeatable predictive results, that the software operates as specified without error."

In response to this comment FRA revises paragraph f (2) to replace the phrase "proper assessment" with the word "assessment," and to specify that "all safety-related software" should be included in the software fault/failure analysis including COTS software.

However, FRA disagrees with the commenter that in the requirement for the software defects to be identified and corrected with the "high degree of confidence" the term "high degree of confidence" requires further clarification. The definition of this term is already given in the preamble discussion for § 236.903 in Subpart H of this Part. (70 FR 11052, 11067.) This term is widely issued in sections of this Part related to safety and risk assessment. Therefore FRA leaves the last sentence of paragraph (f)(2) unchanged.

Paragraph (g) is revised minimally to clarify that MTTHE calculations should account for the restoration time after system or component failure, and that the system design must be assessed for adequacy through Verification and Validation process.

HCRQ/CG, in reference to paragraph (g)(1), repeated its comment given for the last sentence in paragraph (f)(1) that relates to the types of faults (permanent, transient).

FRA notes that the explanations given in the FRA's response to this comment for paragraph (f)(1) are also applicable for this paragraph and therefore retains the text of (g)(1) unchanged.

Paragraph (h) is modified to emphasize the need to document all assumptions made during the risk assessment process. FRA believes that the assumptions should be documented while deriving the total cost of potential accident consequences for full risk assessment or MTTHE values for abbreviated risk assessment, rather than only documenting assumptions for her intermediate parameters, such as MTTF and MTTR, as asked in the previous text of this paragraph. These later two parameters may or may not be relevant for the risk assessment.

FRA received comments from HCRQ/CGI on paragraph (h)(1), in which HCRQ/CGI asserted that the first sentence should be its own paragraph. However, HCRQ/CGI also asserted that the proposed rule text was unclear as to how the railroad would be expected to comply with this requirement.

FRA disagrees with the commenter that the paragraph (h)(1) should be restructured and that the further clarification is required for the process of documenting all assumptions made while deriving the risk metrics that are to be used in the risk assessment for the product. In order for FRA to assess the validity of risk assessment done by railroads for their particular products, all assumptions made by the railroad in regards of deriving chosen risk metrics shall be presented along with the risk assessment. This is critical for the further confirmation that the assumptions made were correct based on the following in-service experience. Documenting assumptions made in the process of risk analysis is rather common procedure recommended by various studies in safety and reliability engineering.

In its comments, HCRQ/CGI also asserted that there is no need to specify an "automated" process for comparing risk assessment assumptions with actual experience. This comment also was made for the similar text in paragraph h (3). Thus, HCRQ/CGI recommended that FRA revise the last sentence of paragraph (h)(1) to read as follows: "The railroad shall document these assumptions in such a form as to permit later comparisons with in-service experience." FRA agrees with this comment and has therefore revised the last sentences of paragraphs (h)(1) and (h)(3) accordingly.

HCRQ/CGI also submitted comments on paragraph (h)(4), asserting that the language in this paragraph seems to imply that a detailed document, separate from the fault trees themselves, is required, which would be very costly. Therefore, HCGI/CGI recommended that FRA revise paragraph (h)(4) to read as follows: "The railroad shall document all of the identified safety critical fault paths to a mishap."

FRA does not see the need to eliminate the clause in the first sentence "as predicted by the safety analysis methodology," but finds it necessary to clarify that no additional tool to that chosen by the railroad for the risk assessment is required by this paragraph.

FRA believes that the changes to Appendix B do not change industry practice, but make both subparts H and I easier to comply with, and therefore the changes do not add any costs or benefits.

4.34 Appendix C to Part 236 – Safety Assurance Criteria and Processes

FRA is modifying Appendix C to part 236 to enhance the language of this appendix, to re-organize the existing list of safe system design principles in accordance with the well established models of system safety engineering, and to augment the list of safe system design principles with the principles related to safe system software design. A safe state is a system configuration that the system defaults to in the event of a fault or failure or when unacceptable or dangerous conditions are detected. The safe state is a state of the process operation where the hazardous event cannot occur.

Paragraph (a) is revised to reflect the main purpose of this appendix in clear, accurate, and consistent language that will be repeatedly used throughout the appendix. It also outlines that the requirements of this appendix will be applicable to railroads' PTCIP as well as PTCSP required by subpart I.

Paragraph (b) is modified and restructured to present in a consistent language a complete list of safety assurance principles properly classified or "categorized" in accordance with well established system safety engineering principles that need to be followed by the designer of the system to assure that all system components performs safely under normal operating conditions and under failures, accounting for human factor impacts, external influencing, and procedures and policies related to maintenance, repair, and modification of the system. The title of this paragraph is changed to outline the mentioned above purpose of this paragraph. FRA also added that these principles must be applicable to PTC systems designed and implemented under requirements of subpart I. FRA's intent in initially promulgating Appendix C was to ensure that safety principles are followed during the design stage and that Verification and Validation methods are used to assure that the product meets the safety criteria established in § 236.909. The heading of this paragraph and its subparagraphs are changed to capture more adequately and precisely this paragraph's purpose. For instance, FRA hereby modifies the heading of paragraph (b)(1) to better suit the chosen base of classification for all safety principles under paragraph (b).

HCRQ/CGI submitted comments asserting that the third sentence of paragraph (b)(1) implies that the system will operate safety in the presence of human error. Questioning whether this would be possible, HCRQ/CGI recommended deletion of this sentence.

In order to avoid ambiguity in interpreting the important requirement spelled out in the third sentence of this paragraph, FRA revises it to read as follows: "The system shall operate safely even in the absence of prescribed operator actions or procedures."

With respect to the fifth sentence in paragraph (b)(1), HCRQ/CGI asserted that it is a rare situation when hazards can be "eliminated". Therefore, HCRQ/CGI recommended that FRA revise the fifth and sixth sentences of proposed paragraph (b)(1) to read as follows: "The safety order of precedence is to eliminate hazards categorized as unacceptable or undesirable. If this is not possible or practical, these hazards should be mitigated to acceptable levels as required by this Part."

FRA agrees with the commenter that the last clause in this paragraph discussing elimination of unacceptable and undesirable hazards requires modification and revises this clause by adding extra clarifying sentence in the final rule for the entire clause to read as follows: "Hazards categorized as unacceptable, which is determined by hazard analysis, must be eliminated by design. Best effort must be made by the designer to also eliminate by design the hazards categorized as undesirable. Those undesirable hazards that cannot be eliminated should be mitigated to the acceptable level as required by this Part."

HCRQ/CGI submitted comments on the first and second sentences of paragraph (b)(2)(ii), asserting that it is not possible to implement a system that would continue to operate safely in the presence of multiple hardware failures. Therefore, HCRQ/CGI recommended that FRA revise the first and second sentences of paragraph (b)(2)(ii) to read as follows: "The product must be shown to operate safely under conditions of random hardware failure. This includes single failures and multiple hardware failures where one or more failures..."

FRA agrees with the commenter that the paragraph requires modification and revises the first two sentences to read as follows: "The product must be shown to operate safely under conditions of random hardware failures. This includes single hardware failures as well as multiple hardware failures that may occur at different times but remain undetected (latent) and react in combination with a subsequent failure as a later time to cause an unsafe operating situation."

HCRQ/CGI asserted that the meaning of each of the last sentences in paragraphs (b)(2)(iii) and (b)(2)(iv) was unclear. In order to address this concern, HCRQ/CGI recommended that the last sentence in paragraph (b)(2)(iii) be revised to read as follows: "Occurrence of credible single point failures that can result in hazards must be detected and the product must achieve a known safe state before inadvertently activating any physical appliance." Similarly, HCRQ/CGI recommended that the last sentence in paragraph (b)(2)(iv) be revised to read as follows: "If one non-self-revealing failure combined with a second failure can cause a hazard that is categorized as unacceptable or undesirable, then the second failure must be detected and the product must achieve a known safe state before inadvertently activating any physical appliance."

FRA agrees with the commenter and revises the referenced sentences in paragraphs (b)(2) (iii) and (b)(2)(iv) for the sentences to end with the following clause: "… the product must achieve a known safe state that eliminates the possibility of false activation of physical appliance."

Under paragraph (b)(3), FRA amends the definition of Closed Loop Principle to reflect its industry accepted definition provided by the AREMA Manual. FRA believes that the previous definition was too general and did not reflect the essence of the most significant principles of safe signaling system design.

HCRQ/CGI submitted comments on the last sentence of paragraph (b)(3), asserting that the sentence is confusing because all system operation is a product of actions and decisions. In order to provide clarification, HCRQ/CGI recommended that FRA revise the last sentence of paragraph (b)(3) to read as follows: "In addition, closed loop design requires that failure to perform a single logical operation, or absence of a single logical input, output or decision shall not cause an unsafe condition, i.e. system safety does not depend upon the occurrence of a single action or logical decision."

FRA has made an effort to perfect the definition of close loop principle in the NPRM and found it satisfactory to adopt the definition given in the 2009 issue of AREMA Communication and Signal Manual of Recommended Practices. FRA does not see the need for further enhancement of this definition.

Under paragraph (b)(4), FRA adds a list of Safety Assurance Concepts that the designer may consider for implementation to assure sail-safe system design and operation. These principles are predominantly applicable for the safe system software design and quoted from the IEEE-1483 standard. Based on this amendment, FRA also renumbers some of the remaining subparagraphs of paragraph (b) to follow the chosen scheme for the proper classification and sequence of safety principles.

GE asserts that more detail is required for the Human Factor Engineering Principle in paragraph (b)(5), which is part of the section on "safety principles during product development." There are two components to applied Human Factor engineering in system safety: the component of ergonomic design and the system risk contribution of the human interaction with the system, along with the degree of dependency on the operator for safety coverage. According to GE, the latter is missing from the discussion and is most relevant to the safety principles section.

In response to this comment FRA would like to emphasize that the main purpose of Appendix C is to provide safety criteria and processes for design of safe systems, or fail-safe, or vital signaling systems that by definition must exclude any hazards associated with human errors. The "reliance factor" or, in other words, the possibility of hazards arising due to overreliance of the operator on the proper functioning of the system itself, which the commenter is referring to, is an issue solely relevant to the non-vital overlays complementing existing method of operation. For non-vital signaling systems the designer must adhere to the safety principles of Appendix C only to the extent necessary to satisfy the safety requirements of this part. Therefore FRA does not see a need for further modification of paragraph (b)(5).

Paragraph (c) is revised to reflect changes in recommended standards. The standard EN50126: 1999, Railway Applications: Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) is superseded by the standard IEC62278: 2002 under the same title. The standard EN50128 (May 2001), Railway Applications: Software for Railway Control and Protection Systems is superseded by the Standard IEC62279: 2002 under the same title.

HCRQ/CGI submitted comments asserting that the U.S. Department of Defense Military Standard (MIL-STD) 882C, "System Safety Program Requirements" (January 19, 1993) has been superseded by U.S. Department of Defense Military Standard (MIL-STD) 882C, "System Safety Program Requirements", Notice 1 (January 19, 1996)".

In the NPRM FRA suggested that railroads follow recommendations of MIL-STD-882C of January 19, 1993 issuance specifically. The Notice I issued on January 19, 1996 does not contain material necessary for the risk analysis, verification and validation processes. Therefore FRA retains the former reference to MIL-STD-882C of January 19, 1993.

Under paragraph (c)(3)(i), FRA references additional IEEE standards that have become available and will support the designs of PTC systems that are widely using communications as their main component. In addition to existing reference under paragraph (c)(3)(i)(A) for IEEE-1483 Standard, the following standards are added to paragraph (c)(3)(i): IEEE 1474.2-2003, Standard for user interface requirements in communications based train control (CBTC) systems; and IEEE 1474.1-2004, Standard for Communications-Based Train Control (CBTC) Performance and Functional Requirements.

After an analysis of the current applicability of ATCS Specification 130 and 140, FRA believes that they are not being used. Thus, FRA hereby removes these standards from the list of referenced standards. However, FRA also adds the ATCS 200, Data Communication standard that remains relevant for communication segment of PTC system designs.

FRA also considers it necessary to reference several additional sections of the current AREMA 2009 Communications and Signal Manual of Recommended Practices. In addition to Section 17 of this manual referenced in a previous version of Appendix C, FRA hereby adds to the list of references Section 16 Vital Circuit and Software Design; Section 21 Data Transmission; and Section 23 Communication-Based Signaling.

FRA believes that the changes to Appendix C reflect current industry practice and do not add to societal benefits or costs.

4.35 Appendix D to Part 236 – Independent Review of Verification and Validation

There has been no change in the underlying engineering principles associated with Appendix D. The changes made in this final rule are cosmetic, simply updating the Appendix so that it is applicable to both Subpart H and I, and reducing the workload both on vendor, the railroad, and FRA. FRA determined that it would have been more burdensome to refer to different Appendices that are functionally identical, and whose only practical difference would be that one referred only to Subpart H, and the other to subpart I of this part.

Paragraph (a) discusses the purpose of an independent third party assessment of product verification and validation. FRA's position that the requirement for an independent third party assessment is reasonably common in the field of safety-critical systems remains unchanged. FRA's recent experience confirms that this approach can enhance the quality of decision making by railroads and FRA. The potential for undergoing a third party audit provides incentives to those who design and produce safety critical systems to more rigorously create and maintain safety documentation for their systems. FRA acknowledges that documentation, by itself, will not ensure a safe system. However, the absence of documentation will make it virtually impossible to ensure the safety of the system throughout its life-cycle. The third party also brings a level of technical expertise, and a perspective that may not be available on the staff of the railroad (or FRA)--in effect, permitting the railroad (and thus FRA) to look behind claims of the vendor to actual engineering practice. This may especially appropriate where the system in question utilizes a novel architecture or relies heavily on COTS hardware and software.

Paragraph (b) establishes the requirements for independence of the third party auditor. The text associated with the underlying principle of independence has simply been clarified to indicate that there must be independence at all levels of the product design and manufacture. This situation has arisen where a third party wished to provide independent safety assessments of the system, but also provide technical support for the design of a component that would be used in the system being reviewed. FRA maintains that such practices, even if the entity in question attempts to firewall the parts of the organization doing the respective tasks, represents a conflict of interest and is unacceptable.

Paragraphs (c) through (f) discuss the substance of the third-party assessment. This assessment should be performed on the system as it is finally configured, before revenue operations commence. The assessor should review the supplier's processes as set forth in the applicable documentation and provide comments to the supplier. The reviewer should be able to determine vulnerabilities in the supplier's processes and the adequacy of the safety analysis (be it in an RSPP and PSP or in a PTCDP and PTCSP) as they apply to the product. "Acceptable methodology" is intended to mean standard industry practice, for example, as contained in MIL-STD-882C. FRA is aware of many other acceptable industry standards, but usage of a less common one in an analysis would most likely require a higher level of FRA scrutiny. In addition, the reviewer considers the completeness and adequacy of the required safety documents.

Paragraph (d) discusses the reviewer's tasks at the functional level. Here, the reviewer will analyze the supplier's methods to establish that they are complete and correct. First, a Preliminary Safety Analysis is performed in the design stage of a product. In addition to describing system requirements within the context of the concept of operations, it attempts, in an early stage, to classify the severity of the hazards and to assign an integrity level requirement to each major function (in conventional terms, a preliminary hazard analysis). Again there are many practices widely accepted within industry such as: Hazard Analysis, Fault Tree Analysis (FTA), Failure Mode and Effects Analysis (FMEA), and Failure Modes, Effects, and Criticality Analysis (FMECA). Other simulation methods may also be used in conjunction with the preceding methods, or by themselves when appropriate. Commonly practiced techniques methods include fault injection, a technique that evaluates performance by injecting known faults at random times during a simulation period; Markov modeling, a modeling technique that consists of states and transitions that control events; Monte Carlo model, a simulation technique based on randomly-occurring events; and Petri-net, an abstract, formal model of information flow that shows static and dynamic properties of a system.

Paragraphs (e) and (f) addresses what must be performed at the implementation level. At this stage, the product is beginning to take form. The reviewer typically evaluates the software, and if appropriate or required, the hardware. In the case of software, the software will most likely be in modular form, such that software modules are produced in accordance to a particular function. In the case of hardware, this may be at the component of line replaceable unit level. The reviewer must select a significant number of modules to be able to establish that product is being developed in a safe manner.

Paragraph (g) discusses the reviewer's tasks at closure. The reviewer's primary task at this stage is to prepare a final report where all product deficiencies are noted in detail. This final report may include material previously presented to the supplier during earlier development stages.

FRA received several comments on Appendix D related to the proper documentation to be reviewed by the third-party reviewer according to paragraph (d)(1), the scope of hazard analysis required to be reviewed by paragraph (d)(2), and the methods of software development techniques to be reviewed according to paragraph (f)(2)(vii). These comments are the same as those submitted by the commenter on the text of Appendix F. Due to the wider applicability of these comments to the material presented in Appendix F, FRA has provided a response to these comments in the section-by-section analysis for Appendix F.

Changes to appendix D are only cosmetic, as noted above, and the changes have no benefits and no costs.

4.36 Appendix E to Part 236 – Human-Machine Interface (HMI) Design

This appendix provides human factors design criteria. Paragraphs (a) through (f) cover the same material as was previously contained in Appendix E. (See 70 Fed. Reg. 11107).
However, Appendix E has been reformatted to support its use for Subparts H and I of this part, and with a few exceptions, is textually the same. This appendix still addresses the basic human factors principles for the design and operation of displays, controls, supporting software functions, and other components in processor-based signal or train control systems and subsystems regardless if they are voluntarily implemented (as is the case with systems qualified under Subpart H of this part) or mandatorily implemented (as is the case with systems developed under Subpart I of this part). The HMI requirements in this appendix attempt to capture the lessons learned from the research, design, and implementation of similar technology in other modes of transportation and other industries. The rationale for each of the requirements associated with paragraphs (a) through (f) remains the same as was presented in the former version of Appendix E (see 70 Fed. Reg. 11107, 11090-11091).

FRA has noted that products implemented under the requirements of Subpart H of this part, or proposed products that will be developed under Subpart I of this part, all have been capable of generating electromagnetic radiation. Such emissions are strictly regulated by the Federal Communications Commission for public safety and health, as well as to ensure that the limited electromagnetic spectrum is optimally utilized. FRA is therefore adding a new paragraph (h) to Appendix E, which requires that as part of the HMI design process, the designer must ensure that the product has the appropriate FCC Equipment Authorization, and that the product meets FCC requirements for Maximum Permissible Exposure limits for field strength and power density. Paragraph (g) does not levy any new regulatory requirements. The requirements cited are mandatory FCC requirements for any device that emits electromagnetic radiation that the system designer must comply with. FRA is simply identifying these requirements, as not all railroad product developers may be aware of them.

The requirements of Appendix E reflect current engineering practice and do not add any benefits or costs.

4.37 Appendix F to Part 236 – Minimum Requirements of FRA Directed Independent Third-Party Assessment of PTC System Safety Verification and Validation

FRA has revised the title of Appendix F in response to comments submitted by GE, in which GE noted that, while FRA may require a railroad to engage in an independent assessment of its PTC system based on the criteria set forth in § 236.913, FRA is not requiring an independent assessment of every PTCSP.

FRA received several comments from HCRQ/CGI on paragraphs (d), (e), (f), and (i) of Appendix F.

The commenter asserted that the term "acceptable methodology" used in the second sentence of paragraph (d) is not clear and suggested that it be replaced with the term "methodologies typical to safety-critical systems". If revised in accordance with this recommendation, the second sentence of paragraph (d) would read as follows: "At a minimum, the reviewer shall compare the supplier processes with methodologies typical of safety-critical systems and employ any other such tests or comparisons if they have been agreed to previously with FRA." In response to this comment FRA notes that the term "acceptable methodologies," by its very nature, includes methodologies typical of safety-critical systems. FRA believes that the proposed modification may artificially limit the use of the atypical analysis methodologies that may provide an equivalent, or better analytical results. Therefore, FRA did not incorporate the proposed change. However, in the interest of providing clarification to reflect the main intent of this paragraph, FRA has modified the second and third sentences in paragraph (d) to read as follows: "At a minimum, the reviewer shall evaluate the supplier design and development process regarding the use of an appropriate design methodology. The reviewer may use the comparison processes and test procedures that have been previously agreed to with FRA."

The commenter also asserted that, with respect to paragraph (e), the reviewer will be required to analyze a "Hazard Log", as opposed to a "Preliminary Hazard Analysis" document, since the Hazard Log will supersede the Preliminary Hazard Analysis on the final stage of the system development process.

FRA agrees with the commenter that the Hazard Log more accurately reflects the perceived risk in the as-built condition, and, therefore, has modified paragraph (e) to read as follows: "The reviewer shall analyze the Hazard Log and/or any other hazard analysis documents for comprehensiveness and compliance with applicable industry, national, and international standards." The commenter also suggested that this comment is equally applicable to former paragraph (d)(1) in the prior version of Appendix D. FRA agrees and has modified paragraph (e) in Appendix D accordingly.

The commenter further suggested that in paragraph (f) the reviewer should be required to analyze samples of the hazard analyses “for completeness, correctness, and compliance with industry, national, or international standards,” as opposed to the proposed requirement to analyze “all” hazard analyses such as Fault Tree Analyses (FTA), Failure Mode and Effects Criticality Analysis (FMECA). The commenter asserted that it will be “difficult and prohibitive” for both the supplier and the reviewer to analyze “all” of these documents in their entire length. The commenter also noted that these comments are applicable to existing Appendix D, paragraph (d)(2).

In response to this comment, FRA notes that there does not appear to be a need for additional clarification on the depth of the quoted documents analysis by the reviewer. As FRA has already indicated in the section-by-section analysis of §236.1017, “FRA has the discretion to limit the extent of the third party assessment.” Moreover, the section-by-section analysis of § 236.1017 goes on to state that “Appendix F represents minimum requirements and that if circumstances warrant, FRA may expand upon the Appendix F requirements as necessary to render a decision that is in the public interest.” FRA will, if appropriate, limit the scope of analysis. FRA notes the comment, and will execute its regulatory discretion in this matter

With respect to paragraph (i)(7), HCRQ/CGI points out that the text of NPRM, while discussing methods of safety-critical software development by the manufacturer, enumerates examples that, according to the commenter, are not particular to the safety-critical systems, which appears to be contrary to the intent of this paragraph. The commenter recommends that FRA include in the text of the final rule an extended list of examples for methods of software development instead of those cited in NPRM, for example, such methods as “system requirement analysis, requirements traceability to functional and derived safety requirements, design analysis, documented peer review,” etc. The commenter also noted that this comment is equally applicable to Appendix D, paragraph (f)(2)(vii).

FRA understands the commenter’s concern. FRA believes that the review should include any documentation associated with the software development that may reflect on, or address, the safety of the system. To address the commenter’s concern and to more accurately reflect FRA's position, paragraph (i)(7) has been revised by deleting the list of examples of methods of software development previously proposed in the NPRM. FRA modifies the text of this paragraph to emphasize that the review on any documentation that may reflect on the safety of software design is required. As with the preceding comment, FRA will exercise its regulatory discretion with regards to the specific documentation based on the system in question and public safety. FRA has also modified paragraph (i)(7) in Appendix D that discusses the same issue.

The requirements of Appendix F reflect current engineering practice and do not have any benefits or costs.

5. General Costs of PTC

The costs anticipated to accrue from adopting this rule will include: (1) costs associated with developing implementation plans and administrative functions related to the implementation and operation of PTC systems, including the information technology and communication systems that make up the central office; (2) hardware costs for onboard locomotive system components, including installation; (3) hardware costs for wayside system components, including installation; and (4) maintenance costs for all system components. The two largest components of initial PTC system acquisition costs are the costs associated with installation of PTC units onboard locomotives, including multiple unit (MU) locomotives and cab cars used in passenger service[18], and along the wayside. All commuter operations connected to the general railroad system of transportation, which include all current commuter rail operations, will be subject to the final rule. Note that PATH is not physically connected to the general freight system yet is considered a commuter railroad for all purposes. PATH formerly was part of the general freight system and remains under FRA safety jurisdiction. Rapid transit systems, such as the Washington Metro Area Transit Authority (WMATA) and New York City Transit Authority (NYCTA), are not impacted by this rule. Comments to the NPRM from the AAR indicate that the Class I freight railroads, entities regulated by this rule, agree, in general, with FRA's cost estimates for PTC system implementation; although the AAR indicated that some costs were likely to be higher and some were likely to be lower, but on balance FRA's total cost estimates were accurate.

5.1 Locomotive Installation Costs

As with other major system installations, the cost of PTC system installation on locomotives will depend on whether it is a retrofit installation or one that is done during manufacture. Most locomotives built in the past 15 years have electronic systems incorporated that would facilitate installation of PTC. Older locomotives might be slightly more expensive to retrofit, and as a consequence they might be retired earlier than planned or transferred for operation in non-PTC territory (either on the same railroad or perhaps on a small railroad). Discussions with railroads and manufacturers of PTC systems yielded a wide range of opinions with respect to locomotive cost implications, however, most members of the RSAC PTC Working Group seemed to think that it would not cost much more to retrofit older equipment. Nevertheless, a fixed investment of some amount, for example the $55,000 per unit of V-TMS used in estimates here, is a larger portion of the total value of a used locomotive than a new one. If a locomotive has a market

[18] Most commuter railroads generally operate one or both of two types of passenger train service: MU locomotive and push-pull. An MU locomotive is a self-propelled rail vehicle that is designed to transport and be occupied by passengers. MU locomotives typically operate semi-permanently coupled together as a pair or triplet with a control cab at each end. During peak commuting hours, multiple pairs or triplets of MU locomotives, or a combination of both, are typically operated together as a single passenger train in MU service. In contrast, push-pull service is passenger train service typically operated with a conventional locomotive in the rear of the train "pushing" the consist with a cab car in the lead position of the train, and with the conventional locomotive in the lead position of the train "pulling" the consist with the cab car in the rear of the train.

value of $75,000 it is much harder to retain that locomotive if it needs a $55,000 PTC system than it is to add the $55,000 to a new locomotive costing $2,000,000. To the extent that installation of PTC components on locomotives results in replacement of some locomotives with new ones, there will be some efficiency gains. Newer locomotives are more fuel efficient, produce fewer emissions, are more easily maintained, and may have other cost savings features that are likely offset the cost of replacement. This effect might even benefit some small railroads that would not be required to install PTC, as it would reduce their locomotive acquisition cost. As noted in the discussion of §236.1029, above, the costs of the locomotive onboard equipment include the expected costs of terminals and display screens.

Class I railroad locomotive counts were derived from "The Official 2009 Edition, Locomotive Rosters and News," by totaling the locomotive counts for each of the seven Class I railroads.

In the Regulatory Flexibility Analysis section below, FRA analyzes the impact on small railroads, and estimates that 240 Class III railroad locomotives will need to be equipped with PTC systems, because they operate on other railroad lines that will be equipped with PTC. Some Class II railroad locomotives may also need to be equipped. However, the number of locomotives that Class II and III railroads will have to equip is roughly the same as the small number of locomotives that Class I railroads may not have to equip. Therefore, the total number of Class I locomotives is a good surrogate for the total number of all freight locomotives that will have to be equipped. There may also be some reduction in the number of Class III locomotives that will need to be equipped, as a result of greater flexibility to exclude track on some passenger lines with limited freight. The number of Class III locomotives to be equipped is already a small number, and the total number which no longer would need to be equipped would be very small, so the change in total costs is not considered in this analysis, as the relative impact on total cost would be negligible. For the entities affected the costs avoided would not be negligible.

Table 1 presents the locomotive related costs. A detailed breakdown of commuter railroad equipment was needed to determine the most likely type of PTC systems that will be implemented on each type of equipment based on the need for interoperability with existing or planned systems. American Public Transportation Association (APTA) member railroad locomotive counts are grouped together by anticipated type of PTC system to the extent practical.

Two railroads, Alaska Railroad (ARR) and PATH, are expected to use unique systems, with little interoperability, so their costs are not presented in Table 1. Costs for ARR are listed separately in Table 3 and costs for PATH will be incurred voluntarily, so they are not included. Future passenger operations are not included, although the unit costs would be similar to those on existing systems. FRA would have to speculate on the likelihood of plans coming to fruition, as well as the likelihood that startup operations would have had PTC systems in the absence of a mandatory requirement. It is fairly likely that PTC systems would be voluntarily included in future high-speed operations. High speed operations around the world rely on advanced train control systems and an order of particular applicability requires ACSES on portions of the Northeast Corridor. FRA requested comments regarding the likelihood of voluntary application on new high speed operations as well as the types of systems that might be used. There were no comments directly addressing the Economic Analysis of the NPRM as it specifically applied to high speed operations.

As noted above, the costs presented below do not include implementation costs for PATH because it is already adopting a system similar to the Communications Based Train Control (CBTC) system used by the New York City Transit Authority on the Canarsie line in order to increase capacity, or the ARR, whose costs are presented separately in Table 3 because the ARR is installing its own version of PTC and its systems does not need to be interoperable with any other system since the ARR does not connect with other railroads except through barge service. The costs included in this analysis for the ARR are for more extensive switch monitoring and track integrity circuits. ARR has and would continue to incur other PTC implementation costs in absence of this rule and RSIA08.

In developing cost estimates, FRA assumed that railroads connecting with the Northeast Corridor would use ACSES compatible technology. ACSES technology can have higher unit costs, in part because the onboard units must pick up transponder signals from beneath the train, as well as data transmitted by radio. Both require additional equipment. Further, ACSES equipment may be more expensive because it has to respond to data on a shorter cycle. It is this shorter cycle, with shorter response time, which makes ACSES relatively a better choice for the higher density operations of the Northeast Corridor. FRA is in no way mandating that any railroad adopt any particular technology, but is estimating costs based on what FRA thinks are the most logical ways to meet the mandate. Of course, if a railroad were to disagree with this analysis, it could install another system with corresponding different costs and benefits. FRA notes that, in order to be fully functional, ACSES must be combined with cab signals and automatic train control. As the NRPM was prepared, FRA lacked detailed information regarding whether or to what extent railroads in the northeast might find it necessary to install cab signal equipment on additional rail lines in order to take advantage of ACSES. FRA is aware that New Jersey Transit has already made these investments and that both of the NYSMTA railroads have non-signaled lines for which “main line” exceptions will apparently be requested. FRA requested comment regarding these additional potential costs, but received no specific comments regarding cab signal installations, or other specific costs of extending ACSES to railroads other than Amtrak. FRA has monitored discussions among railroads on how best to achieve interoperability in the Northeast. Amtrak and the freight railroads have devised a plan to transmit VTMS compatible messages through ACSES data radios and to design ACSES equipment to accept VTMS messages. FRA has also learned that MARC and MBTA have already begun procurement and installation of ACSES equipment. Thus the cost to install equipment for units to be equipped with ACSES and VTMS is much lower than estimated in the Regulatory Impact Analysis that accompanied the NPRM. None of the freight equipment will need additional equipment, and the modifications to the ACSES system on the passenger locomotives and cab cars will be of much more modest cost, $10,000, with no costs attributed to acquisition of ACSES system equipment, as the acquisition would have occurred in the absence of this rulemaking.

Table 1

Onboard Equipment Costs

Number of commuter RR units, excluding PATH	All units	unit cost	Total Cost	2 cab
APTA locomotives	492			
APTA, single cab, cab car/MU, 1 level	2,186			
APTA, single cab, cab car/MU, 2 level	637			
APTA, double cab, MU, 1 level	98			98
APTA, double cab, MU, 2 level	0			0
APTA, double cab, MU,1 level, articulated	4			4
MBTA locomotives	83			
MBTA cab cars	84			
NM Railrunner locomotives	5			
NM Railrunner cab cars	5			
NJT locomotives	155			
NJT EMUs	230			
NJT assumed cab cars, single cab	155			
Total commuter units	**4,134**			**102**
Commuter units excluded				
Alaska RR cab cars	4			4
Alaska RR locomotives	58			
Total Alaska RR	62			4
Total commuter units, excluding ARR and PATH	**4,072**			**98**
Additional costs for equipping second cabs		**$ 15,000**	**$ 1,470,000**	
Units to be equipped with ACSES only				
Amtrak locomotives	0			
Connecticut DOT cab cars	14			
Connecticut DOT locomotives	8			
LIRR cab cars	1,025			
LIRR locomotives	69			
Metro North cab cars	896			
Metro North locomotives	46			
SEPTA cab cars	382			71
SEPTA locomotives	8			
Total equipped with ACSES only	**2,448**	**$ 80,000**	**$ 195,840,000**	**71**
ACSES equipped units needing V-TMS add-on				
Amtrak locomotives	20			
MBTA locomotives	83			
MBTA cab cars	84			
MARC cab cars	27			
MARC locomotives	36			
Freight locomotives	0			
Total equipped with ACSES and V-TMS	**250**	**$ 10,000**	**$ 2,500,000**	

Units to be equipped V-TMS only			
Commuter Units	1394		
Amtrak locomotives	366		
Freight locomotives, Class 1	27,598		
Total equipped with V-TMS only	**29,358**	**$ 55,000**	**$ 1,614,690,000**
Total Onboard costs			**$ 1,814,500,000**
Installed Second Screen Costs	27,598	$ 8,000	**$ 220,784,000**

5.2 Wayside Installation Costs

Wayside installation costs are estimated based on assumptions made above regarding application of either VTMS or ACSES and cost estimates from the 1999 Report, updated to current dollars. These are presented in Table 2. As with locomotive costs, costs for ARR and PATH are not included. These two railroads are expected to adopt PTC systems that are different from those adopted by the rest of the industry. The ARR system costs are presented in Table 3 and are treated as a single purchase including all system components, while the already planned PATH system is assumed to be funded as a voluntary transit improvement, intended to boost capacity.

Having considered comments on the NPRM related to passenger operations on low volume non-PTC freight routes FRA has provided exclusions, using an MEA, in the final rule that will permit such operations under certain circumstances. FRA estimates that exclusions provided in the final rule, under §236.1019 (c)(3) and (4), will reduce the requirements to equip right of way by 1,900 miles. FRA believes these segments pose a negligible risk, and therefore will not appreciably affect the estimated safety benefits of the final rule. Furthermore, FRA does not believe that the affected lines have enough traffic to contribute to the business benefits estimated in Appendix A, so FRA has not adjusted the estimated business benefits from implementing PTC as required by the final rule.

FRA also considered requests for de minimis exceptions for freight lines with negligible risk from PIH traffic, and provided for such exceptions in §236.1005 of the final rule. FRA estimates that 3,208 miles of freight railroad right-of-way will be excepted under de minimis provisions, however only 304 miles will be totally unaffected by the final rule. The remaining 3,204 miles of track subject to de minimis exceptions will still be subject to requirements to provide mitigations at a lower cost. FRA estimates that implementation of such mitigations will cost the railroads an average of $10,000 per mile. The values of exceptions and exclusions are shown as negative numbers in Table 2, while the mitigations, new costs, are shown as positive numbers.

Table 2

Wayside Equipment Costs

ACSES	miles	Unit cost	Total cost
1998 cost and mileage	198		$ 20,250,000
Implied Unit cost, 1998		$ 102,273	
Inflation factor			1.1803
Estimated Unit Cost		$ 120,713	
Miles to be equipped with ACSES			
LIRR	308		
Metro North	271.6		
NJT	313.6		
SEPTA	94.2		
Total	**987.4**	**$ 120,713**	**$ 119,191,523**
New Cab Signals Required			
LIRR ABS	136	$ 20,000	$ 2,720,000
Metro North Dark Territory	58.7	$ 60,000	$ 3,522,000
Metro North TCS	51.06	$ 20,000	$ 1,021,200
Total	**245.8**		**$ 7,263,200**
Miles to be equipped with V-TMS	**68,700**	**$ 50,000**	**$ 3,435,000,000**
Total Wayside costs before exclusions and exceptions			**$ 3,561,454,723**
Passenger Miles to be excluded by MEA	1,900	-$ 50,000	-$ 95,000,000
Freight Miles to be excepted by MEA	3,508	-$ 50,000	-$ 175,400,000
Freight Miles of new mitigations with MEA	3,204	$ 10,000	$ 32,040,000
Total Wayside costs after exclusions and exceptions			**$ 3,323,094,723**

5.3 Total PTC System Installation Costs (Including Central Office)

Railroads will also incur costs associated with developing implementation plans and administrative functions related to the implementation and operation of PTC systems, including the information technology and communication systems that make up the central office. It is tempting to look at costs of consumer electronics, which have been dropping since 1998, and ask if PTC systems would be less expensive now, as well. Unfortunately, much of the cost associated with PTC systems is for system development, which must be performed under rigorous conditions in order to avoid costly unintended consequences. Central office costs, if anything, have increased since 1998, with inflation, although some software development tools may have reduced the time needed to perform some functions.

Table 3 presents total PTC system costs. PTC cost estimates used in this analysis are based on discussions with RSAC participants and others over the course of more than a decade of experience in estimating PTC costs. FRA is aware of lower estimates, which typically did not include installation costs, and much higher estimates, which often involved what FRA believes are unreasonable expectations of difficulties in retrofitting older equipment. The estimates from individuals who have actually installed, or been involved in the bid process for installations, are more consistent with the estimates used in this analysis. FRA believes that its onboard equipment cost estimates are likely in the upper bound, however actual equipment costs may vary for one or more systems. It would not be unreasonable for actual locomotive equipment costs to total as low as 60% of this estimate or as high as 125% of the estimate. FRA believes that its wayside costs may be in the lower bound. Wayside costs are not likely to be less than 80% of that, however, costs could be twice as high if more wayside units are required than we expect. FRA believes that its central office and development costs are likely in the upper bound. Cooperation and collaboration among industry participants could significantly reduce development costs. FRA believes that central office and development costs could be as low as 40% of its estimates, but no more than 50% higher than its estimates. FRA has taken the high and low estimates for each cost category, and derived total system cost range of from 71% to 176% of FRA's best estimates for total system acquisition costs.

Table 3

	Units	Unit cost	Total Cost	Low cost	High cost
Onboard Equipment	see Table 1		$ 1,814,500,000	$ 1,088,700,000	$ 2,268,125,000
Wayside Equipment	see Table 2		$ 3,323,094,723	$ 2,658,475,778	$ 6,646,189,445
Central Office Equipment	20	$15,000,000	$ 300,000,000	$ 120,000,000	$ 450,000,000
Alaska Railroad			$ 30,000,000	$ 30,000,000	$ 30,000,000
Total system acquisition costs			$ 5,467,594,723	$ 3,897,175,778	$ 9,394,314,445
Annual Maintenance	15.00%		$ 820,139,208	$ 584,576,367	$ 1,409,147,167

Railroads have until December 31, 2015 to implement PTC systems. Not all components will be phased in at the same rate. FRA has made some assumptions about the phase-in by component type. FRA assumes that development and central office acquisition will occur first, in roughly equal increments of 20% of total installed costs over five years, starting in 2009. FRA assumes that wayside systems acquisition will start in 2011 and with a smaller portion in the first year, building up to a much larger portion in the final year of acquisition, 2015; specifically, 5% in the first year, 10% in the second year, 15% in the third year, 30% in the fourth year, and 40% in the fifth and final year. FRA assumes that onboard system acquisition will occur in roughly equal increments of 20% of total installed costs over five years, starting in 2011.

Further, a life cycle cost is calculated, over a service life of 20 years. Annual maintenance costs are assumed to be 15% of installed system costs at the end of the previous year. Electronic systems may even have a greater annual maintenance cost if the components must be replaced frequently, because the components are no longer manufactured as technology brings chips and other electronic equipment with greater capabilities to the general market. It is unlikely that a chip maker will maintain production of an obsolete chip just to serve the railroad market, which is very small relative to the total market for processors. Discounted life-cycle costs are calculated using both 3% and 7% annual discount factors. The maintenance costs exceed the initial procurement costs over the twenty year period, as shown in Tables 4a through 4f.

Expected PTC costs are detailed in Tables 4a and 4b, which present annual breakdowns, Tables 4c and 4d present high cost scenarios. Tables 4e and 4f present low cost scenarios. Tables 4a, 4c, and 4e present costs in current dollars using a 7% discount rate, while Tables 4b, 4d, and 4f present current costs based on a 3% discount rate. Tables 4a through 4f also present expected railroad accident reduction benefits, which are discussed in the following section of this analysis.

Because the circumstances of the ARR cost accruals are distinct from other railroads included in this analysis, they are presented separately in Tables 4g and 4h.

This analysis discusses the total cost of each PTC system component. However, each component has a paperwork requirement, whether for configuration management, training, maintenance, hazard log or something else. All such costs are included in aggregate form, and there is no separate paperwork estimate in this regulatory impact statement. Some paperwork requirements may already reflect current industry practices, and would not as a result be a new burden of the final rule, even if they qualify as a paperwork burdens for the analysis required under the Paperwork Reduction Act.

5.4 Impacts of Extending the Implementation Schedule

RSIA08 requires the railroads to have all mandatory PTC systems operational on or before December 31, 2015. Members of the PTC Working Group, especially railroad and supplier representatives, said that the timeframe was very tight, and that the scheduled implementation dates would be difficult to meet. In general, the faster a government agency requires a regulated entity to adopt new equipment of procedures, the more expensive compliance becomes. In part, this is due to supply elasticity being less over shorter time periods.

FRA is unable to estimate the potential savings if Congress provided a longer implementation schedule or provided incentives, rather than mandates, for PTC system installation. In order to estimate the likely reduction in costs in such situations, FRA would need to develop some other schedule for implementation. The element least sensitive to an implementations schedule appears to be onboard costs. Each PTC system's onboard equipment seems similar and is not very different from existing onboard systems. Further, the 2015 deadline is not so restrictive that it would cause railroads to pull locomotives out of service just to install on board PTC equipment. Locomotives must be inspected thoroughly every 90 days and more extensively every 360 days. The inspections can last from one to several days. Railroads usually bring locomotives into their shops to perform these inspections, during which time a skilled and experienced team could install the on board equipment for PTC.   The impact on system development is much less certain, and more time would enable vendors to develop, test, and implement the software at a more reasonable cost. Wayside costs are also sensitive to the installation timetable, as the wayside must be mapped and measured, and then the railroads must install wayside interface units (WIUs). Wayside mapping and measurement takes a highly skilled workforce. A larger workforce is necessary to timely implement the required PTC systems in a shorter amount of time. WIU installation is likely similar to existing signal or communication systems installation, and is likely to involve use of existing railroad skilled workers. The shorter the installation time period, the more work will be done at overtime rates, which are, of course, higher.

FRA believes that lower costs could result from a longer installation period, but FRA also believes that the differences in costs would be within the range of the low costs provided in the main analysis of the final rule. The 2004 report included some lower cost estimates, but in light of current discussions with railroads, the cost estimates in the 1998 report seem more accurate. The lower estimates FRA received in preparing the 2004 report were both overly optimistic, and excluded installation costs, as well as higher costs that stem from meeting the performance standards.

Table 4a

Discount Rate		Expected Case								
7%					Total			Discounted		Discounted
Year	Discount Factor	Development & Central Office	Wayside Costs	Onboard Costs	Installed Costs	Maintenance Cost	Annual Cost	Annual Cost	Annual Benefit	Annual Benefit
2009	1.00	$ 60,000,000	$ 0	$ 0	$ 60,000,000	$ 0	$ 60,000,000	$ 60,000,000	$ 0	$ 0
2010	0.93	$ 60,000,000	$ 0	$ 0	$ 120,000,000	$ 9,000,000	$ 69,000,000	$ 64,485,981	$ 0	$ 0
2011	0.87	$ 60,000,000	$ 166,154,736	$ 362,900,000	$ 709,054,736	$ 18,000,000	$ 607,054,736	$ 530,225,117	$ 1,953,566	$ 1,706,320
2012	0.82	$ 60,000,000	$ 332,309,472	$ 362,900,000	$ 1,464,264,208	$ 106,358,210	$ 861,567,683	$ 703,295,870	$ 6,511,885	$ 5,315,638
2013	0.76	$ 60,000,000	$ 498,464,208	$ 362,900,000	$ 2,385,628,417	$ 219,639,631	$ 1,141,003,840	$ 870,466,366	$ 13,023,771	$ 9,935,772
2014	0.71	$ 0	$ 996,928,417	$ 362,900,000	$ 3,745,456,834	$ 357,844,263	$ 1,717,672,679	$ 1,224,676,881	$ 32,559,427	$ 23,214,422
2015	0.67	$ 0	$ 1,329,237,889	$ 362,900,000	$ 5,437,594,723	$ 561,818,525	$ 2,253,956,414	$ 1,501,906,329	$ 55,351,026	$ 36,882,726
2016	0.62	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 507,939,106	$ 65,118,854	$ 40,552,750
2017	0.58	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 474,709,445	$ 65,118,854	$ 37,899,766
2018	0.54	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 443,653,687	$ 65,118,854	$ 35,420,342
2019	0.51	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 414,629,614	$ 65,118,854	$ 33,103,123
2020	0.48	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 387,504,312	$ 65,118,854	$ 30,937,499
2021	0.44	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 362,153,563	$ 65,118,854	$ 28,913,550
2022	0.41	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 338,461,274	$ 65,118,854	$ 27,022,009
2023	0.39	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 316,318,947	$ 65,118,854	$ 25,254,214
2024	0.36	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 295,625,185	$ 65,118,854	$ 23,602,070
2025	0.34	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 276,285,219	$ 65,118,854	$ 22,058,009
2026	0.32	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 258,210,485	$ 65,118,854	$ 20,614,962
2027	0.30	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 241,318,210	$ 65,118,854	$ 19,266,319
2028	0.28	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 225,531,038	$ 65,118,854	$ 18,005,906
Total	11.33559524							$ 9,497,396,632		$ 439,705,397

Table 4b

Discount Rate 3.00% — Expected Case

Year	Discount Factor	Development & Central Office	Wayside Costs	Onboard Costs	Total Installed Costs	Maintenance Cost	Annual Cost	Discounted Annual Cost	Annual Benefit	Discounted Annual Benefit
2009	1.00	$ 60,000,000	$ 0	$ 0	$ 60,000,000	$ 0	$ 60,000,000	$ 60,000,000	$ 0	$ 0
2010	0.97	$ 60,000,000	$ 0	$ 0	$ 120,000,000	$ 9,000,000	$ 69,000,000	$ 66,990,291	$ 0	$ 0
2011	0.94	$ 60,000,000	$ 166,154,736	$ 362,900,000	$ 709,054,736	$ 18,000,000	$ 607,054,736	$ 572,207,311	$ 1,953,566	$ 1,841,423
2012	0.92	$ 60,000,000	$ 332,309,472	$ 362,900,000	$ 1,464,264,208	$ 106,358,210	$ 861,567,683	$ 788,456,479	$ 6,511,885	$ 5,959,298
2013	0.89	$ 60,000,000	$ 498,464,208	$ 362,900,000	$ 2,385,628,417	$ 219,639,631	$ 1,141,003,840	$ 1,013,767,133	$ 13,023,771	$ 11,571,452
2014	0.86	$ 0	$ 996,928,417	$ 362,900,000	$ 3,745,456,834	$ 357,844,263	$ 1,717,672,679	$ 1,481,679,542	$ 32,559,427	$ 28,086,048
2015	0.84	$ 0	$ 1,329,237,889	$ 362,900,000	$ 5,437,594,723	$ 561,818,525	$ 2,253,956,414	$ 1,887,653,012	$ 55,351,026	$ 46,355,613
2016	0.81	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 663,189,317	$ 65,118,854	$ 52,947,588
2017	0.79	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 643,873,123	$ 65,118,854	$ 51,405,425
2018	0.77	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 625,119,537	$ 65,118,854	$ 49,908,179
2019	0.74	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 606,912,172	$ 65,118,854	$ 48,454,543
2020	0.72	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 589,235,118	$ 65,118,854	$ 47,043,246
2021	0.70	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 572,072,930	$ 65,118,854	$ 45,673,054
2022	0.68	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 555,410,612	$ 65,118,854	$ 44,342,771
2023	0.66	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 539,233,604	$ 65,118,854	$ 43,051,234
2024	0.64	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 523,527,771	$ 65,118,854	$ 41,797,315
2025	0.62	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 508,279,389	$ 65,118,854	$ 40,579,917
2026	0.61	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 493,475,135	$ 65,118,854	$ 39,397,978
2027	0.59	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 479,102,073	$ 65,118,854	$ 38,250,464
2028	0.57	$ 0	$ 0	$ 0	$ 5,437,594,723	$ 815,639,208	$ 815,639,208	$ 465,147,643	$ 65,118,854	$ 37,136,373
								$ 13,135,332,191		$ 673,801,919

Table 4c

Discount Rate 7%		High Cost Case								
Year	Discount Factor	Development & Central Office	Wayside Costs	Onboard Costs	Total Installed Costs	Maintenance Cost	Annual Cost	Discounted Annual Cost	Annual Benefit	Discounted Annual Benefit
2009	1.00	$ 90,000,000	$ 0	$ 0	$ 90,000,000	$ 0	$ 90,000,000	$ 90,000,000	$ 0	$ 0
2010	0.93	$ 90,000,000	$ 0	$ 0	$ 180,000,000	$ 13,500,000	$ 103,500,000	$ 96,728,972	$ 0	$ 0
2011	0.87	$ 90,000,000	$ 332,309,472	$ 453,625,000	$ 1,055,934,472	$ 27,000,000	$ 902,934,472	$ 788,657,937	$ 1,953,566	$ 1,706,320
2012	0.82	$ 90,000,000	$ 664,618,945	$ 453,625,000	$ 2,264,178,417	$ 158,390,171	$ 1,366,634,115	$ 1,115,580,527	$ 6,511,885	$ 5,315,638
2013	0.76	$ 90,000,000	$ 996,928,417	$ 453,625,000	$ 3,804,731,834	$ 339,626,763	$ 1,880,180,179	$ 1,434,380,457	$ 13,023,771	$ 9,935,772
2014	0.71	$ 0	$ 1,993,856,834	$ 453,625,000	$ 6,252,213,667	$ 570,709,775	$ 3,018,191,609	$ 2,151,928,904	$ 32,559,427	$ 23,214,422
2015	0.67	$ 0	$ 2,658,475,778	$ 453,625,000	$ 9,364,314,445	$ 937,832,050	$ 4,049,932,828	$ 2,698,641,247	$ 55,351,026	$ 36,882,726
2016	0.62	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 874,743,661	$ 65,118,854	$ 40,552,750
2017	0.58	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 817,517,440	$ 65,118,854	$ 37,899,766
2018	0.54	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 764,034,990	$ 65,118,854	$ 35,420,342
2019	0.51	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 714,051,393	$ 65,118,854	$ 33,103,123
2020	0.48	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 667,337,750	$ 65,118,854	$ 30,937,499
2021	0.44	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 623,680,141	$ 65,118,854	$ 28,913,550
2022	0.41	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 582,878,636	$ 65,118,854	$ 27,022,009
2023	0.39	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 544,746,389	$ 65,118,854	$ 25,254,214
2024	0.36	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 509,108,775	$ 65,118,854	$ 23,602,070
2025	0.34	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 475,802,593	$ 65,118,854	$ 22,058,009
2026	0.32	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 444,675,321	$ 65,118,854	$ 20,614,962
2027	0.30	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 415,584,412	$ 65,118,854	$ 19,266,319
2028	0.28	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 388,396,647	$ 65,118,854	$ 18,005,906
Total								$ 16,198,476,189		$ 439,705,397

Table 4d

Discount Rate 3%

High Cost Case

Year	Discount Factor	Development & Central Office	Wayside Costs	Onboard Costs	Total Installed Costs	Maintenance Cost	Annual Cost	Discounted Annual Cost	Annual Benefit	Discounted Annual Benefit
2009	1.00	$ 90,000,000	$ 0	$ 0	$ 90,000,000	$ 0	$ 90,000,000	$ 90,000,000	$ 0	$ 0
2010	0.97	$ 90,000,000	$ 0	$ 0	$ 180,000,000	$ 13,500,000	$ 103,500,000	$ 100,485,437	$ 0	$ 0
2011	0.94	$ 90,000,000	$ 332,309,472	$ 453,625,000	$ 1,055,934,472	$ 27,000,000	$ 902,934,472	$ 851,102,340	$ 1,953,566	$ 1,841,423
2012	0.92	$ 90,000,000	$ 664,618,945	$ 453,625,000	$ 2,264,178,417	$ 158,390,171	$ 1,366,634,115	$ 1,250,663,812	$ 6,511,885	$ 5,959,298
2013	0.89	$ 90,000,000	$ 996,928,417	$ 453,625,000	$ 3,804,731,834	$ 339,626,763	$ 1,880,180,179	$ 1,670,515,737	$ 13,023,771	$ 11,571,452
2014	0.86	$ 0	$ 1,993,856,834	$ 453,625,000	$ 6,252,213,667	$ 570,709,775	$ 3,018,191,609	$ 2,603,518,594	$ 32,559,427	$ 28,086,048
2015	0.84	$ 0	$ 2,658,475,778	$ 453,625,000	$ 9,364,314,445	$ 937,832,050	$ 4,049,932,828	$ 3,391,754,984	$ 55,351,026	$ 46,355,613
2016	0.81	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 1,142,106,688	$ 65,118,854	$ 52,947,588
2017	0.79	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 1,108,841,444	$ 65,118,854	$ 51,405,425
2018	0.77	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 1,076,545,092	$ 65,118,854	$ 49,908,179
2019	0.74	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 1,045,189,409	$ 65,118,854	$ 48,454,543
2020	0.72	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 1,014,746,999	$ 65,118,854	$ 47,043,246
2021	0.70	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 985,191,262	$ 65,118,854	$ 45,673,054
2022	0.68	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 956,496,370	$ 65,118,854	$ 44,342,771
2023	0.66	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 928,637,253	$ 65,118,854	$ 43,051,234
2024	0.64	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 901,589,566	$ 65,118,854	$ 41,797,315
2025	0.62	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 875,329,676	$ 65,118,854	$ 40,579,917
2026	0.61	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 849,834,636	$ 65,118,854	$ 39,397,978
2027	0.59	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 825,082,171	$ 65,118,854	$ 38,250,464
202	0.57	$ 0	$ 0	$ 0	$ 9,364,314,445	$ 1,404,647,167	$ 1,404,647,167	$ 801,050,652	$ 65,118,854	$ 37,136,373

8		
	$ 22,468,682,123	$ 673,801,919

Table 4e

Discount Rate		Low Cost Case								
7%					Total			Discounted		Discounted
Year	Discount Factor	Development & Central Office	Wayside Costs	Onboard Costs	Installed Costs	Maintenance Cost	Annual Cost	Annual Cost	Annual Benefit	Annual Benefit
2009	1.00	$ 24,000,000	$ 0	$ 0	$ 24,000,000	$ 0	$ 24,000,000	$ 24,000,000	$ 0	$ 0
2010	0.93	$ 24,000,000	$ 0	$ 0	$ 48,000,000	$ 3,600,000	$ 27,600,000	$ 25,794,393	$ 0	$ 0
2011	0.87	$ 24,000,000	$ 132,923,789	$ 217,740,000	$ 422,663,789	$ 7,200,000	$ 381,863,789	$ 333,534,622	$ 1,953,566	$ 1,706,320
2012	0.82	$ 24,000,000	$ 265,847,578	$ 217,740,000	$ 930,251,367	$ 63,399,568	$ 570,987,146	$ 466,095,595	$ 6,511,885	$ 5,315,638
2013	0.76	$ 24,000,000	$ 398,771,367	$ 217,740,000	$ 1,570,762,733	$ 139,537,705	$ 780,049,072	$ 595,095,702	$ 13,023,771	$ 9,935,772
2014	0.71	$ 0	$ 797,542,733	$ 217,740,000	$ 2,586,045,467	$ 235,614,410	$ 1,250,897,143	$ 891,872,375	$ 32,559,427	$ 23,214,422
2015	0.67	$ 0	$ 1,063,390,311	$ 217,740,000	$ 3,867,175,778	$ 387,906,820	$ 1,669,037,131	$ 1,112,149,914	$ 55,351,026	$ 36,882,726
2016	0.62	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 361,242,408	$ 65,118,854	$ 40,552,750
2017	0.58	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 337,609,727	$ 65,118,854	$ 37,899,766
2018	0.54	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 315,523,109	$ 65,118,854	$ 35,420,342
2019	0.51	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 294,881,410	$ 65,118,854	$ 33,103,123
2020	0.48	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 275,590,103	$ 65,118,854	$ 30,937,499
2021	0.44	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 257,560,844	$ 65,118,854	$ 28,913,550
2022	0.41	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 240,711,069	$ 65,118,854	$ 27,022,009
2023	0.39	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 224,963,616	$ 65,118,854	$ 25,254,214
2024	0.36	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 210,246,370	$ 65,118,854	$ 23,602,070
2025	0.34	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 196,491,935	$ 65,118,854	$ 22,058,009
2026	0.32	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 183,637,322	$ 65,118,854	$ 20,614,962
2027	0.30	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 171,623,666	$ 65,118,854	$ 19,266,319
2028	0.28	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 160,395,949	$ 65,118,854	$ 18,005,906

$ 6,679,020,129	$ 439,705,397

Table 4f

Discount Rate 3% — Low Cost Case

Year	Discount Factor	Development & Central Office	Wayside Costs	Onboard Costs	Total Installed Costs	Maintenance Cost	Annual Cost	Discounted Annual Cost	Annual Benefit	Discounted Annual Benefit
2009	1.00	$ 24,000,000	$ 0	$ 0	$ 24,000,000	$ 0	$ 24,000,000	$ 24,000,000	$ 0	$ 0
2010	0.97	$ 24,000,000	$ 0	$ 0	$ 48,000,000	$ 3,600,000	$ 27,600,000	$ 26,796,117	$ 0	$ 0
2011	0.94	$ 24,000,000	$ 132,923,789	$ 217,740,000	$ 422,663,789	$ 7,200,000	$ 381,863,789	$ 359,943,245	$ 1,953,566	$ 1,841,423
2012	0.92	$ 24,000,000	$ 265,847,578	$ 217,740,000	$ 930,251,367	$ 63,399,568	$ 570,987,146	$ 522,534,124	$ 6,511,885	$ 5,959,298
2013	0.89	$ 24,000,000	$ 398,771,367	$ 217,740,000	$ 1,570,762,733	$ 139,537,705	$ 780,049,072	$ 693,063,497	$ 13,023,771	$ 11,571,452
2014	0.86	$ 0	$ 797,542,733	$ 217,740,000	$ 2,586,045,467	$ 235,614,410	$ 1,250,897,143	$ 1,079,034,864	$ 32,559,427	$ 28,086,048
2015	0.84	$ 0	$ 1,063,390,311	$ 217,740,000	$ 3,867,175,778	$ 387,906,820	$ 1,669,037,131	$ 1,397,792,321	$ 55,351,026	$ 46,355,613
2016	0.81	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 471,655,170	$ 65,118,854	$ 52,947,588
2017	0.79	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 457,917,640	$ 65,118,854	$ 51,405,425
2018	0.77	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 444,580,233	$ 65,118,854	$ 49,908,179
2019	0.74	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 431,631,295	$ 65,118,854	$ 48,454,543
2020	0.72	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 419,059,509	$ 65,118,854	$ 47,043,246
2021	0.70	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 406,853,893	$ 65,118,854	$ 45,673,054
2022	0.68	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 395,003,779	$ 65,118,854	$ 44,342,771
2023	0.66	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 383,498,815	$ 65,118,854	$ 43,051,234
2024	0.64	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 372,328,946	$ 65,118,854	$ 41,797,315
2025	0.62	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 361,484,414	$ 65,118,854	$ 40,579,917
2026	0.61	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 350,955,742	$ 65,118,854	$ 39,397,978
2027	0.59	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 340,733,730	$ 65,118,854	$ 38,250,464
2028	0.57	$ 0	$ 0	$ 0	$ 3,867,175,778	$ 580,076,367	$ 580,076,367	$ 330,809,446	$ 65,118,854	$ 37,136,373

$ 9,269,676,781	$ 673,801,919

Table 4g

Phase In analysis

Discount Rate

7%			Alaska	Total			Discounted
Year	Discount		Railroad	Installed	Maintenance	Annual	Annual
	Factor		Costs	Costs	Cost	Cost	Cost
2009	1.00		$ 0	$ 0	$ 0	$ 0	$ 0
2010	0.93		$ 0	$ 0	$ 0	$ 0	$ 0
2011	0.87		$ 1,500,000	$ 1,500,000	$ 0	$ 1,500,000	$ 1,310,158
2012	0.82		$ 3,000,000	$ 4,500,000	$ 225,000	$ 3,225,000	$ 2,632,561
2013	0.76		$ 4,500,000	$ 9,000,000	$ 675,000	$ 5,175,000	$ 3,947,983
2014	0.71		$ 9,000,000	$ 18,000,000	$ 1,350,000	$ 10,350,000	$ 7,379,407
2015	0.67		$ 12,000,000	$ 30,000,000	$ 2,700,000	$ 14,700,000	$ 9,795,231
2016	0.62		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,802,374
2017	0.58		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,619,041
2018	0.54		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,447,702
2019	0.51		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,287,572
2020	0.48		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,137,918
2021	0.44		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 1,998,054
2022	0.41		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 1,867,340
2023	0.39		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 1,745,178
2024	0.36		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 1,631,007
2025	0.34		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 1,524,306
2026	0.32		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 1,424,585
2027	0.30		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 1,331,388
2028	0.28		$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 1,244,287
							$ 50,126,089
Annualized ARR Cost		$ 4,731,548					

Table 4h

Phase In analysis

Discount Rate

3%		Alaska	Total			Discounted
Year	Discount	Railroad	Installed	Maintenance	Annual	Annual
	Factor	Costs	Costs	Cost	Cost	Cost
2009	1.00	$ 0	$ 0	$ 0	$ 0	$ 0
2010	0.97	$ 0	$ 0	$ 0	$ 0	$ 0
2011	0.94	$ 1,500,000	$ 1,500,000	$ 0	$ 1,500,000	$ 1,413,894
2012	0.92	$ 3,000,000	$ 4,500,000	$ 225,000	$ 3,225,000	$ 2,951,332
2013	0.89	$ 4,500,000	$ 9,000,000	$ 675,000	$ 5,175,000	$ 4,597,920
2014	0.86	$ 9,000,000	$ 18,000,000	$ 1,350,000	$ 10,350,000	$ 8,928,001
2015	0.84	$ 12,000,000	$ 30,000,000	$ 2,700,000	$ 14,700,000	$ 12,311,019
2016	0.81	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 3,658,912
2017	0.79	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 3,552,342
2018	0.77	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 3,448,875
2019	0.74	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 3,348,423
2020	0.72	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 3,250,896
2021	0.70	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 3,156,209
2022	0.68	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 3,064,281
2023	0.66	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,975,030
2024	0.64	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,888,379
2025	0.62	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,804,251
2026	0.61	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,722,574
2027	0.59	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,643,276
2028	0.57	$ 0	$ 30,000,000	$ 4,500,000	$ 4,500,000	$ 2,566,287
						$ 70,281,900
Annualized ARR Cost		$ 4,724,048				

5.5 PTC Benefits

The primary benefit of PTC implementation is the safety benefits or savings expected to accrue from the reduction in the number and severity of casualties arising train accidents that would occur on lines equipped with PTC systems. In addition, benefits related to accident preventions would accrue from a decrease in damages to property such as locomotives, railroad cars, and track; environmental damage; track closures; road closures; and evacuations. Benefits more difficult to monetize--such as the avoidance of hazardous material accident related costs incurred by Federal, state, and local governments and impacts to local businesses--will also result. FRA also expects that once PTC systems are refined there will be substantial additional business benefits resulting from more efficient and reliable transportation service; however such benefits are not included in the total benefits.

5.6 Accident Reduction Benefits

As discussed in the regulatory analysis of the NPRM, in 2005, as part of the ongoing effort to study the effectiveness of PTC at preventing accidents, the Volpe Center estimated its rail safety benefits for the period 1988 – 2001, a span of 14 years. The estimate was based on a pool of 728 PTC-preventable accidents (PPA) identified by a joint FRA and industry working group and accident cost factors from the 1999 report. This analysis showed that implementation of PTC systems with essentially the same characteristics as systems that would meet the final rule's requirements would have resulted in accident cost savings totaling $827,743,610.96, an average annual cost savings of $59,124,543.64, and an average accident cost savings of $1,137,010.45. Accident costs included costs associated with casualties as well as various other factors discussed in detail below. Since these cost estimates were developed, the Department of Transportation has increased its estimate of the willingness to pay to avoid a fatality from $2.7 million to $6 million, by a factor of 2.222. On the other hand, changes in GDP (http://cost.jsc.nasa.gov/inflateGDP.html), indicate that prices rose by a factor of 1.5143 from 1988 (the first year of the study) to 2008, and 1.1158 from 2001 (the last year of the study) to 2008. Using the GDP deflator value for 1995 to 2008, which would be the midpoint GDP deflator value for the period of study, yields a price increase of 1.238 from the midpoint of the study period to 2008. In analyzing the NPRM, FRA used an inflator value slightly greater than 1.7 (the average of 2.222 and 1.238) to update costs from the Volpe study yielding annual PPA costs of approximately $105,000,000 in current dollars. In accordance with the findings of a more recent analysis of those PPA costs performed in support of this rulemaking, FRA will use a different value that more accurately reflects the true costs of preventing the PPAs.

In an effort to breakdown the cost elements associated with the PPAs, FRA asked the Volpe Center to perform the same analysis it had in 2005 using updated dollar values for the various cost elements. The resultant monetary values were lower than those generated in 2005. In response to the unexpected discrepancy between the results of the two analyses, the Volpe Center carefully reviewed the procedures used in its more current analysis and believes that the lower more recent costs are correct. FRA has revised its benefit estimates accordingly. For purposes of this analysis, FRA is using a cost of PPAs over the 14 year period of $895,274,224, with an average annual PPA cost of $63,948,159. To derive these estimates, the Volpe Center updated the fatality and injury cost estimates to reflect the current DOT willingness to pay to avoid a fatality value of $6 million. Other damage estimates, such as the cost of train delay or evacuation, have been updated using the GDP inflator for converting 1998 dollars to 2009 dollars. Actual reported damage values, such as equipment and track damage, were updated using the actual year value inflated to 2009 dollars applying the GDP deflator.

5.7 PPA Cost Factors from the 1999 Report

The cost factors discussed below are the basis for the PPA estimates presented above. They were derived by consensus of the Economics Team of the PTC Working Group and were published in the 1999 report. All costs were measured in 1998 constant dollars.

Equipment Damage

The Economics Team could not discern a difference between the costs of damage to passenger equipment reported to FRA and the societal cost of the damage. The Team agreed that the best estimator of passenger equipment damage is the reported damage. Passenger equipment is often insured for replacement value, so sometimes equipment damage is reported as the cost of replacement equipment, which is likely an overestimate. Other times the equipment is reported as the depreciated value of the equipment. There does not seem to be a pattern that would produce a scaling factor.

Track and Right-Of-Way Damage

It appears that actual damage reported for track and right-of-way damage is fairly accurate, and reflects societal costs. It may be underestimated in some cases as the full extent of the repair costs may not be captured, but in other cases it may be overestimated as older track and right-of-way may be repaired to better than pre-accident condition. This appeared to the Economics Team to balance out over time, and not to be correlated with any reported characteristics. For purposes of the study the Economics Team agreed to use the reported damage to track and wayside.

Damage Off the Right-of-Way

Some damage may occur to property not on the right-of-way, for example when an overspeed train derails, damaging a building owned by someone other than the railroad. The Economics Team estimated average damage at $2,000 per PTC-preventable accident[19]. Such damage is rare, and cannot easily be attributed to an accident based on any characteristics reported

Hazardous Materials Cleanup

If an accident involves a release of hazardous materials, there may be a cost to clean up the hazardous material and remediate (restore) the environment. Based on data from actual

[19] Yard and highway-rail grade crossing accidents are excluded from any definition of PTC preventable accident considered here.

settlements and judgments in such cases, the Economics Team estimated the cost of cleanup and remediation at $250,000 per hazardous material car releasing. The Team considered using a single cost per incident in which hazardous material was released, but thought that it would be at least as good to base the estimated cost on cars releasing to provide some measure of the severity of the accident. This measure is still far from perfect, as some accidents involving single car releases may have resulted in far more costly clean-ups than some multi-car releases, yet it is the best measure the Team could agree upon.

Evacuations

Accidents may lead to evacuations, either because of real or perceived threats to safety from hazardous material releases. The Team estimated the societal cost of an evacuation from data on 77 evacuations for which it had data on the duration of the evacuation. These accidents were not necessarily PTC preventable (most were not) and occurred between 1993 and 1997. The Team estimated the value of time at $11.70 per hour per person, plus 30%, or $15.21 per hour. It added 30% to reflect the involuntary and unplanned nature of the costs imposed. Unfortunately, one accident, at Weyauwega, Wisconsin, on March 4, 1996, dominated the costs. The Weyauwega evacuation lasted 426 hours, while the next longest evacuation lasted 43 hours. The average cost per evacuation was $986 with the Weyauwega evacuation, and $267 without. The Weyauwega evacuation was clearly an outlier, but nevertheless relevant, so the Economics Team compromised on an estimate of $500 per evacuation.

Loss Of Lading

If there is an accident involving a loaded freight car, there may be a loss to society as a result of loss or damage to lading. In this case railroad payments to shippers are probably very close to the societal cost of lading loss and damage, which based on data from the AAR was estimated as roughly $6,500 per loaded freight car derailed, a figure the Team agreed upon.

Wreck Clearing

Locomotives or cars that are derailed or destroyed need to be removed from the right of way. Railroads costs for this include the cost of mobilizing a crane or rerailing equipment to the accident site and the cost of employing that equipment. The Team estimated that the cost of mobilizing equipment to an accident site is $2,500 per incident where cars or locomotives are derailed. Once the equipment is there, the Team estimated that it would cost $750 to rerail, wreck or transport a freight locomotive that had derailed, and $300 to rerail, wreck or transport a derailed freight car.

Rerailing passenger equipment can be far more costly. The equipment is more expensive, and may be less robust than freight equipment. It needs to be handled with more care. The sites of passenger accidents are more likely to be in urban areas where the right of way is constrained, as in tunnels and sunken routes under streets. Further, the NTSB is far more likely to investigate a passenger train accident, so there may be significant costs while the rerailing/wrecking equipment sits near the accident site, awaiting NTSB's permission to clear the accident. Four commuter railroads' data suggests that the cost per incident of clearing equipment is roughly $75,000 per accident in which passenger cars or locomotives are derailed. The Team agreed with this estimate.

Train Delays

If a train is derailed it will block the track it is on, and may block adjacent tracks too. The Team estimated that the average blockage would last two hours. If affected trains arrive randomly, the average train delay would be one hour, for freight trains and fifteen minutes for passenger trains, which are likely to be switched around a delay. The Team estimated the average cost per hour of freight train delay at $250 per hour. Thus the estimated cost of a delay would be freight trains per day divided by twelve (the expected number of trains in two hours), times one (the average expected delay) times the cost per hour of a delay ($250).

The Team estimated the cost of passenger train delays, based on 285 passengers per train (a national average), an average duration of blockage of 2 hours (which implies passenger trains per day/12 are affected), an average per train delay of 15 minutes, and an average value of passenger time of $25 per hour. This relatively high per hour value of time is related to the income of train passengers. Many commuter lines have average passenger household incomes in excess of $75,000 per year.

Multiplying 285 passengers per train, $25 per passenger hour, and 1/4 hour yields a cost of $1781.25 per train. The Team estimated the number of passenger trains affected as trains per day divided by 12, to reflect 24 hours per day divided by two hours duration of blockage. To get the average cost of passenger train delay, $1781.25 is divided by twelve to get $148.44, which must then be multiplied by the number of passenger trains per day.

5.8 Headline Accidents

Notable accidents are always investigated, and as a consequence the cause code is commonly recorded as "under investigation." Therefore, they were generally not captured by data queries used to establish the PPA database. This database may also under-represent such accidents because they are so infrequent they did not occur in the time period. For example, an accident that occurred on February 16, 1996, in Silver Spring, Maryland, resulted in 11 fatalities, but is not in the PPA database. An article in the online version of the International Herald Tribune, dated September 14, 2008, lists fourteen train accidents, starting with one in 1910. Four of these accidents were PTC preventable accidents that occurred between 1972 and 2005. Included in this group were the Graniteville, South Carolina accident and the three listed below. The recent accident at Chatsworth, California that had just occurred was not listed. Including the Chatsworth accident, five headline PPAs occurred between 1969 and 2008, killing 106 people. These accidents are very rare, unique in circumstance, and very hard to predict or avoid. Nevertheless after each accident, FRA took steps to avoid such accidents and to mitigate the outcome of those that might occur. Some of the safety initiatives included the issuance of regulations addressing training, operating rules for calling of signals, drug testing, crashworthiness of cars and locomotives, hazardous materials routing (FRA assisted PHMSA in this developing this rule) , and passenger train emergency preparedness. While this analysis extensively discusses the accidents that occurred at Graniteville, South Carolina and Chatsworth, California, this analysis also includes fatalities resulting from the following three accidents included in the 2008 Herald Tribune article:

- Feb. 16, 1996: Amtrak's locomotive-led Capitol Limited sideswiped a cab car-led Maryland commuter train at a crossover switch in Silver Spring, Maryland. All three crew members and eight passengers on the commuter train died.
- Jan. 4, 1987: An engineer drove three linked Conrail engines through a closed track switch and into the path of Amtrak train near Chase, Md., killing 16 and injuring 175.
- Oct. 30, 1972: Two Illinois Central commuter trains collided during morning rush hour in Chicago, killing 45 and injuring more than 200.

FRA has studied quite extensively of the consequences of the January 6, 2005 accident in Graniteville, South Carolina and estimates the total cost of the accident as $189,154,845 based on the following information.

The Graniteville accident resulted in 9 fatalities and more than 550 injuries. It was the deadliest train accident involving a hazardous material in nearly three decades. At 2:39 a.m. on January 6, 2005, a train crashed into a locomotive and two cars on a siding in Graniteville, South Carolina. A tank car containing chlorine was punctured in the shell by the coupler of another car and released chlorine. The release affected commercial and residential areas of the city. Approximately 5,400 residents were evacuated from a 1-mile radius around the accident site. About 554 people complaining of respiratory difficulties were taken to local hospitals. Of those, 75 were admitted for treatment. Nine people died from exposure to chlorine gas. Fifteen people were placed on ventilators in intensive care units. Twenty-five people were hospitalized for more than 3 days. Twenty-six people were hospitalized for 1 to 2 days. There were 68 repeat visits to the emergency department, 58 people with significant symptoms and 98 with moderate symptoms. Forty-one people who visited the emergency department were released and 13 people were treated at a physician's office.

The monetary impact of the injuries sustained as a result of the Graniteville accident is estimated using the Abbreviated Injury Scale (AIS). One criterion for a reportable injury is that the injury requires medical treatment. Because one criterion of an AIS 2 injury is that it almost always requires treatment, it can be assumed that all injuries reported are at least AIS 2. Of the 554 people taken to the hospital, it was reported that 75 were admitted for treatment. It was further reported that 9 died, 15 people were placed on ventilators, 25 people were hospitalized for more than 3 days, and 26 people were hospitalized for 1 or 3 days. In the interest of being conservative, and without more specific information, an AIS 2 - moderate will be assessed for 479 persons and the remaining 75 persons admitted will be assessed as AIS 3 - severe.

Authorities evacuated homes and businesses within a mile of the crash, affecting about 5,400 people. Some were away from their homes for more than a week. On January 14, 2005, approximately 1,500 Graniteville residents were allowed to return to their homes. By January 17, 2005, an estimated 4,500 people had returned home, including the 1,500 individuals who had previously returned home on January 14. On January 19, 2005, residents remained displaced from an estimated 75 homes in the immediate area of the derailment.

The Graniteville incident caused some local businesses to have a dramatic drop in business immediately after the accident. Part of the reason for this drop was because parts U.S. Highway 1 were closed due to the deadly chlorine cloud. After four days the highway was opened but it had signs that noted that it was open only to local traffic.

Table 5

Graniteville Accident Cost

Rail Hazardous Material Incident Summary

Negative Impact	People Involved		Pecuniary Value
Fatalities	9		$54,000,000
Injuries - AIS 1	0		$0
Injuries - AIS 2	479		$44,547,000
Injuries - AIS 3	75		$25,875,000
Injuries - AIS 4	0		$0
Injuries - AIS 5	0		$0
Evacuation ($200 / day / person)	5,400	52,350 days	$10,470,000
Property Damage			$6,900,000
Environmental Cleanup (Diesel Fuel Only)	1		$162,845
Environmental Cleanup - Other			
Track Out of Service	$2 Mill/day	23 days	$46,000,000
Road Closure	$300,000/day	4 days	$1,200,000
Total Value:			**$189,154,845**

Evacuation	$200	Per Day Per Person	52,350 total

FRA has also developed a preliminary estimate of the Chatsworth, California accident cost. The accident resulted in 25 fatalities and a total of $382,856,856 in monetized accident costs.

Table 6
Chatsworth Accident Cost

Casualties

	Number	Cost Per	Total (Million $)
Fatalities (AIS 6)	25	$ 6,000,000	$ 150,000,000
AIS 1 (minor)*	23.75	$ 12,000	$ 285,000
AIS 2 (moderate)*	23.75	$ 93,000	$ 2,208,750
AIS 3 (serious)*	23.75	$ 345,000	$ 8,193,750
AIS 4 (severe)*	23.75	$ 1,125,000	$ 26,718,750
AIS 5 (critical)	40	$ 4,575,000	$ 183,000,000
Total			**$ 370,406,250**

According to FRA 39i -- 84

Train Delay

Passengers - Day 1 immediate	Number Pass	Number	Cost / Hour	Hours
Pass - Day 1 later	225	4	$ 43.51	3
Passengers - Subsequent days	225	30	$ 43.51	1.5
	225	40	$ 43.51	1

UP	Number		Hours
Freight - local	1	$ 420	21
Freight - other	4	$ 420	279
Total	$126,000		

Rolling Stock Equipment

Metrolink	Number	Cost Per	Total	Notes
Locomotive	1	$ 3,000,000	$ 3,000,000	Completely
Coach	1	$ 2,000,000	$ 2,000,000	Completely
Coach damage	2	$ 500,000	$ 1,000,000	
UP				
Lead locomotive	1	$ 500,000	$ 500,000	
Trailing locomotive	1	$ 150,000	$ 150,000	
Cars	7	$ 100,000	$ 700,000	
Lading damage	7	$ 300,000	$ 2,100,000	
Total			**$ 9,450,000**	

Emergency Response

	Number	Cost Per Hour	Hours	Total
Fire *	270	$ 50	36	$ 486,000
LAPD / Sheriffs*	210	$ 50	36	$ 378,000
Others (Highway Patrol,	15	$ 50	36	$ 27,000
Total				**$ 891,000**

Equipment Clean Up

	Number	Hourly Rate	Hours	Total
Labor	28	$ 50	35	$ 49,000
Heavy Equipment Used	7	$ 3,000	35	$ 735,000
Biohazard remediation	5	$ 100	16	$ 8,000
Total				**$ 784,000**

Equipment Derailed: 1 Metrolink

Track Damage

		Cost Per	Total
1,000 feet	1000	$ 250	$ 250,000
Total			**$ 250,000**

Chatsworth Incident Cost

Casualties	$ 370,406,250
Train Delay	$ 1,075,606
Damaged Rolling Stock	$ 9,450,000
Emergency Response	$ 891,000
Equipment Clean Up	$ 784,000
Track Damage	$ 250,000
Total	**$ 382,856,856**

Between the Graniteville and Chatsworth accidents, there were a total of 34 fatalities and $572,011,701 total costs including fatality costs, or an average of $16,823,874 in total damages per fatality. If that ratio had been the same at all the other headline PPA's then the total cost of those accidents, involving 106 fatalities, would have been $1,783,330,597 over 40 years, with an expected annual cost of $44,583,265.

The table below breaks down these benefits by fatalities and other accident costs, including non-fatal injuries.

Table 7

Headline Accidents (40 years)

	# fatalities	$ fatalities	$ Injuries and Other damages
Chatsworth	25	$ 150,000,000	$ 232,856,856
Graniteville	9	$ 54,000,000	$ 135,154,845
Total	34	$ 204,000,000	$ 368,011,701
Average per fatality	**1**	**$ 6,000,000**	**$ 10,823,874**
Chatsworth	25	$ 150,000,000	$ 270,596,839
Graniteville	9	$ 54,000,000	$ 97,414,862
Silver Spring	11	$ 66,000,000	$ 119,062,609
Chase, MD 1987	16	$ 96,000,000	$ 173,181,977
Chicago 1972	45	$ 270,000,000	$ 487,074,310
Total	106	$ 636,000,000	$ 1,147,330,597
Average per incident	**21.2**	**$ 127,200,000**	**$ 229,466,119**
Yearly (divide by 40)	**2.65**	**$ 15,900,000**	**$ 28,683,265**

5.9 Total Railroad Safety Benefits from PTC Preventable Accidents

Total railroad safety benefits are the sum of "baseline" PPA costs of $63,948,159 per year and "headline" PPA costs $44,583,265 per year, which total $108,531,424 per year. FRA estimates that approximately one third of these benefits would be attributable to fatality avoidance. Virtually all PPA's occurred on the very broad PTC system required by RSIA08, and defined in the final rule. The remaining portion of the system tends to have lower speeds and densities, reducing both the likelihood of PPAs and the potential severity of those accidents. Such accidents would have a negligible impact on this analysis, thus there is no need to reduce the estimated benefit to account for PPAs unaffected by the proposed systems.

As mentioned above, FRA has instituted many countermeasures that might have helped mitigate or avoid these accidents. For purposes of this analysis, FRA assumes that 25% of the annual PPA costs would be reduced through countermeasures already instituted. FRA does not believe that PTC will be 100 percent effective in reducing the remaining PPAs, although FRA believes it will be very effective. For purposes of this analysis, FRA assumes that PTC will be 80% effective. Applying an 80% effectiveness rate to the 75% of PPA costs not already addressed by countermeasures yields a potential 60% cost reduction. Thus, FRA is estimating that 60% of all PPA costs will be eliminated once PTC is fully implemented. The expected annual savings would then be $65,118,854 (60% of $108,531,424) once PTC is fully implemented. The breakdown of the savings by category is presented in Table 8 below. For shares of discounted total benefits, and annualized benefits, FRA uses the corresponding percentages presented below:

Table 8

Savings	Headline	Volpe PPA	Total	Percentage
Fatalities	$9,540,000	$16,457,143	$25,997,143	39.92%
Injuries	$13,600,498	$6,113,333	$19,713,831	30.27%
Train Delay	$2,201,477	$169,259	$2,370,736	3.64%
Property Damage	$776,294	$14,604,570	$15,380,864	23.62%
Emergency Response	$41,667	$0	$41,667	0.06%
Equipment Clean Up	$36,664	$205,872	$242,535	0.37%
Road Closure	$56,118	$0	$56,118	0.09%
Environmental Cleanup	$7,615	$619,303	$626,918	0.96%
Evacuations	$489,626	$199,416	$689,042	1.06%
Total	$26,749,959	$38,368,895	$65,118,854	

FRA believes these benefits will be phased in as PTC systems are installed and are thus applied in greater proportion as the system is completed. Even the early installations will result in some portion of the total potential benefit. For instance, a locomotive equipped with PTC will not let its crew exceed limits of authority nor will it let it over-speed. Further, at least in signaled territory the onboard PTC system will warn of an unequipped train exceeding the limits of its authority, helping the crew of an equipped train avoid an accident that would have been caused by an error aboard the unequipped train. FRA's estimate of this phase-in schedule of benefits is shown in Table 9. Note that these factors were used in Tables 4a-4f to calculate 20-year life cycle benefits.

Table 9

Benefit Phase In

Year	Percent
2011	3.00%
2012	10.00%
2013	20.00%
2014	50.00%
2015	85.00%
2016	100.00%

5.10 Business Benefits

FRA conducted a sensitivity analysis that takes into account potential business benefits from realizing service efficiencies and related additional societal benefits from environmental attainment and an overall reduction in transportation risk from modal diversion. Note that business benefits are not included for the ARR.

FRA analyzed business benefits associated with PTC system implementation and presented its findings in a letter report to Congress in 2004. Due to the aggressive implementation schedule for PTC, FRA has not formally updated this study. Economic and technical feasibility of the necessary system refinements and modifications to yield the potential business benefits has not yet been demonstrated. Nevertheless, FRA believes that there is opportunity for significant business benefits to accrue several years after implementation, once the systems have been refined to the degree necessary. The 2004 report included business benefits from improved or enhanced locomotive diagnostics, fuel savings attributable to train pacing, precision dispatch, and capacity enhancement. The improvements in dispatch and capacity have further implications. With those improvements railroads could increase the reliability of shipment arrival time, and thus dramatically increase the value of rail transportation to shippers, who in turn would divert certain shipments from highway to rail.

At the time, railroads argued that FRA's estimates of business benefits to the railroads were exaggerated. However, shortly after the report was published several railroads announced to investors and other industry insiders that the railroads were proceeding with PTC systems, and that those systems would bring significant profit to the railroads.

The two biggest components of business benefits identified in the 2004 analysis came from increased capacity, and precision dispatching, which offered the greatest opportunity for benefits. At present, the PTC systems contemplated by the railroads, with the possible exception of PATH, would not increase capacity, at least not for some time. If the braking algorithms need to be made more conservative in order to ensure that trains do not exceed the limits of their authority, PTC may actually decrease capacity in the early years. As noted earlier, PATH is apparently considering the system used by the New York City Transit Authority on the Canarsie line. This system, which is known as Communication-Based Train Control, is not similar in concept to any of the other PTC systems (including the CSX CBTC, with which its name might easily be confused), and would not be suitable, as FRA understands the system, except on a railroad with operating characteristics similar to a heavy rail mass transit system, which PATH has. FRA believes that even in absence of this rule and RSIA08 PATH would adopt PTC for business reasons, and just as in the case where FRA requires a railroad to adopt a current business practice, FRA is neither claiming benefits nor costs associated with implementation of PTC on PATH in this analysis.

The main business benefit of PTC would be derived from precision dispatch, which decreases the variance of arrival times of delivered freight. Over time, if shippers realize that they could count on a more accurate arrival time of freight, then they could reduce the stock that they keep in inventory as a precaution against running out of stock. It costs shippers approximately 25% of the value of inventory, regardless of the material being stored, to store that inventory for a year. This estimate accounts for shrinkage, borrowing costs, and storage costs. Freight with more value per unit of mass or volume tends to have greater storage costs per unit. At present, no such precision dispatch system exists. Accurate train data is a necessary, but not a sufficient condition, for precision dispatch. At least two of the Class I railroads have attempted to develop precision dispatch systems but have not been successful. The mandatory installation of PTC is likely to divert any resources that might have been devoted to precision dispatch, so these benefits are unlikely during the first ten years of this rule.

In the years since the 2004 report, developing technology and rising fuel costs have caused the rail supply industry and the railroads to focus on additional means of conserving diesel fuel while minimizing in-train forces that can lead to derailments and delays from train separations (usually broken coupler knuckles). Software programs exist that can translate information concerning throttle position and brake use, together with consist information and route characteristics, to produce advice for prospective manipulation of the locomotive controls to limit in-train forces. Programs are also being conceived that project arrival at meet points and other locations on the railroad. These types of tools can be consolidated into programs that either coach the locomotive engineer regarding how to handle the train or even take over the controls of the locomotive under the engineer's supervision. The ultimate purpose of integrating this technology is to conserve fuel use while handling the train properly and arriving at a designated location "just in time" (e.g., to meet or pass a train or enter a terminal area in sequence ahead of or behind other traffic). Further integrating this technology with PTC communications platforms and traffic planning capability could permit transmittal of "train pacing" information to the locomotive cab in order to conserve fuel. Like the communications backbone, survey data concerning route characteristics can be shared by both systems.

The diesel fuel use for road operations to the Class I railroads is approximately 3.5 billion gallons annually, which is $8.75 billion at $2.50 per gallon. If PTC helps to potentiate the growth and effective use of train pacing, fuel savings of 5% ($437,500,000 annually) or greater could very likely be achieved. Clearly, if the railroads are able to conserve use of fuel, they will also reduce emissions and contribute to environmental attainment, even before modal diversion occurs.

5.11 Additional Societal Benefits

Clearly, if the railroads are able to conserve use of fuel, they will also reduce emissions and contribute to environmental attainment, even before the modal diversion discussed below. There are also potential additional societal benefits that could result downstream once the systems are refined and efficiencies allow rail to compete more effectively in certain markets and divert certain traffic from highways to rail.

To assess the potential for highway to rail diversion in its 2004 report, FRA employed the Department of Transportation's Intermodal Transportation and Inventory Cost (ITIC) model, which measures shipper logistics cost for both highway and rail. Business that rail can capture from highway results in shipper logistics cost savings. Many of the benefits estimated to accrue in 2010 were based on implementation by 2010. Note that given the current state of implementation, they are more likely to accrue several years after PTC is implemented.

Applying current factors to the analysis used in the 2004 report to Congress, indicates that diversion could result in annual highway safety benefits of $744 million by 2022, and $1,148 million by 2032. Of course, these benefits require that the productivity enhancing systems be added to PTC, and are heavily dependent on the underlying assumptions of the 2004 model.

Modal diversion would also yield environmental benefits. The 2004 report implied reduced air pollution costs would have been between $68 million and $132 million in 2010 (assuming PTC would be implemented by 2010), and between $103 million and $198 million in 2020. This benefit would have accrued to the general public. FRA has not broken out the pollution cost benefit of the current rule, but offers the estimates from the 2004 report as a guide to the order of magnitude of such benefits.

Modal diversion is highly sensitive to service quality. It may be true that problems with terminal congestion and lengthy dwell times might overwhelm the benefits of PTC; or it may be that the other initiatives which the railroads have been pursing (reconfiguration of yards, pre-blocking of trains, shared power arrangements, car scheduling, AEI, etc.) might actually work in synergy with PTC.

It should be noted that, in the years since the 2004 Report was developed, the Class I railroads have shown an increased ability to retain operating revenue as profit, rather than surrendering it in the form of reduced rates. This was particularly true during the period prior to the current recession, when strained highway capacity favored the growth of rail traffic. Accordingly, the precise partition of business and societal benefits cannot be estimated with any certainty.

The sensitivity analysis performed by FRA indicates that realization of business benefits could yield benefits sufficient to close the gap between PTC implementation costs and rail accident reduction benefits within the first 20 years of the rule applying a 3% discount rate and by year 25 of the rule, applying a discount rate of 7%. Appendix A of this document presents the findings of this analysis in detail.

5.12 Relationship Between Benefits and Costs, and Timing of Implementation

Once PTC is fully implemented, annual maintenance costs will be approximately $816 million, and the annual railroad accident prevention benefits will be approximately $65 million. Obviously a system which costs $5.4 billion initially, and then costs another $816 million per year to maintain does not make a lot of sense financially if the returns are limited to $65 million per year. Safety benefits include prevention of the following:

- Casualties (Value of a Statistical Life = $6 Million)
- Equipment Damage
- Track and Right-of-Way Damage
- Damage Off Right-of-Way
- Hazardous Material Cleanup
- Evacuation (e.g., Hazmat)
- Loss of Lading
- Wreck Clearing
- Train Delays

For purposes of its primary analysis FRA has not assumed any business benefits, beyond those from railroad accident prevention. Several railroads affected by RSIA08 are already developing PTC and would very likely be proceeding absent this rulemaking or the statutory requirement. These railroads have in the past claimed that there were no additional business benefits to be gained by implementing PTC, beyond safety benefits. Their behavior, in adopting PTC, however, would appear to contradict their statements to FRA that they expect no additional business benefits. FRA’s letter report to Congress on the Benefits and Costs of PTC projected that railroads would generate significant business benefits from PTC, but would retain a very small portion of total societal benefits. As noted above, there has been more recent evidence that railroads are able to retain revenues generated through efficiencies (much of which has been reinvested to renew infrastructure or expand capacity).

According to the 2004 study railroads could gain between $675,000,000 and $1,318,000,000 per year in business benefits through use of PTC. If railroads are voluntarily adopting PTC, then their revealed preferences strongly suggest that they believe the benefits are likely to be at least as great as those projected in the letter report to Congress. FRA believes that the opportunity for such business benefits will not occur for several years, but that when those opportunities do present themselves the railroads will take advantage of them.

FRA's analysis (see Tables 4a-4h) presents a 20-year analysis of the costs and benefits associated with FRA's final rule, using both 7 percent and 3 percent discount rates, including net present value (PV) and annualized value, which is the annuity required at the discount rate to yield the total over the analysis period. It also presents sensitivity analyses associated with varying cost assumptions used for estimating PTC implementation costs. The 20-year total cost estimates are $9.55billion (PV, 7%) and $13.21 billion (PV, 3%). Annualized costs are $.87 billion (PV, 7%) and $.88 billion (PV, 3%). Using high-cost assumptions, the 20-year total cost estimates would be $16.25 billion (PV, 7%) and $22.54 billion (PV, 3%). Using low-cost assumptions, the 20-year cost estimates would be $6.73 billion (PV, 7%) and $9.34 billion (PV, 3%).

Twenty-year railroad safety (railroad accident reduction) benefit estimates associated with implementation of the final rule are $440 million (PV, 7%) and $674 million (PV, 3%). Annualized benefits are $42 million (PV, 7%), and $45 million (PV, 3%).

Table 10

Summary of Costs and Benefits

Total 20-Year Discounted Costs and Benefits (at 3% and 7%)

Discount Rate	3.00%	7.00%
Costs		
Central Office and Development	$283,025,904	$263,232,675
Wayside Equipment	$2,902,751,825	$2,414,794,033
On-Board Equipment	$1,613,568,678	$1,390,618,364
Maintenance	$8,406,267,684	$5,478,877,649
Total	$13,205,614,091	$9,547,522,721
Benefits by Category		
Fatalities	$268,999,278	$175,541,848
Injuries	$203,984,196	$133,114,717
Train Delay	$24,530,630	$16,008,043
Property Damage	$159,149,846	$103,857,000
Emergency Response	$431,143	$281,353

Equipment Clean Up	$2,509,576	$1,637,683
Road Closure	$580,664	$378,926
Environmental Cleanup	$6,486,888	$4,233,172
Evacuations	$7,129,699	$4,652,654
Total Railroad Safety Benefits	$673,801,919	$439,705,397

Sensitivity analysis performed by FRA indicates that realization of business benefits could yield benefits sufficient to close the gap between PTC implementation costs and rail accident reduction benefits within the first 18 years of the rule applying a 3% discount rate and by year 24 of the rule, applying a discount rate of 7%.

FRA recognizes that the likelihood of business benefits is uncertain and that the cost-to-benefit comparison of this rule, excluding any business benefits, is not favorable. However, FRA has taken measures to minimize the rule's adverse impacts and to provide as much flexibility as FRA is authorized to grant under RSIA08.

As far as timing of the investment and its returns, in the first years while the systems are being implemented, the safety benefits will probably be gained more than in proportion to the degree of implementation. If half the rolling stock is equipped, then at least those units will avoid the collisions that could have been caused by a crew error in those units, while on PTC territory, and probably those units will also avoid collisions with unequipped units when the onboard PTC system warns the PTC equipped crew of other trains outside the limits of the other train's authority. Assuming that right of way is equipped with higher risk segments assigned higher priority, and that the railroads make some effort to use equipped locomotives in the lead, it is likely that the greater risk on more heavily traveled corridors will make the use of equipped units on that territory relatively more beneficial.

Appendix A – Business Benefits

In analyzing the benefits and costs of the final rule, FRA alludes to potential business benefits, which raises an obvious question. Could the business benefits cited in the 2004 report offset the costs of PTC, or even create a net benefit? The 2004 report found that net benefits in excess of a billion dollars a year, measured in 2003 dollars, were possible. Of course, the 2004 report relied on assumptions that certain technologies could be developed, and that those technologies would be used to optimize business benefits. The 2004 report acknowledged significant technical and economic barriers to implementation of the necessary "Add-On" technologies. There may be institutional barriers to overcome as well. In this appendix, FRA explains how it integrated the 2004 report and the analysis of the final rule to examine potential business benefits in light of the RSIA08 mandate for PTC and the final rule.

First FRA updated 2003 dollar values used in the 2004 report. FRA used the GDP deflator calculator at http://cost.jsc.nasa.gov/inflateGDP.html, which shows that a 2003 dollar is equivalent to 1.1007 current 2009 dollars, to update the values of direct and indirect shipper benefits. FRA also updated the cost of highway accidents, doubling it from 0.13 per diverted mile to 0.26 per diverted mile, because DOT has doubled the Value of a Statistical Life (VSL) used for analytical purposes since the 2004 report.

Second, for this Add-On analysis FRA chose to focus on only one of the two types of PTC systems included in the 2004 report—the one most comparable to the PTC systems that will be installed in response to RSIA08. FRA believes that a productivity system can be added to the currently proposed V-TMS types of systems that will generate benefits comparable to those that would be generated by PTC B in the 2004 study. FRA further decided to use single-point estimates for costs and benefits for ease of analysis. To arrive at such estimates, FRA took arithmetic averages of the high and low cost and benefit estimates from the 2004 report.

The third adjustment FRA made was to address potential fuel savings. FRA believes that the business benefits of PTC may include significant fuel savings. Test runs at several railroads indicate that the difference in fuel consumption between the best and worst locomotive engineers is approximately 30%. Railroads have shown that training can narrow that gap. FRA believes that with PTC and a productivity enhancing system using the PTC data, that fuel savings of 5% are very likely attainable. Translating that into monetary terms is not simple since, in recent years, fuel consumption and prices have varied from year to year. For the past several years, Class I railroads have been consuming slightly over four billion gallons each year and per gallon costs have risen. Based on information available, FRA believes a price of $2.50 per gallon is reasonable for use in this analysis. Since not all railroad fuel consumption is for road use and the actual percentage for road use varies from railroad to railroad, FRA is conservatively estimating that 12.5%, or one eighth, of total fuel consumption is for yard use and 87.5%, or at least 3.5 billion gallons, is for road use. Applying a savings rate of 5% to the 3.5 billion gallons at a cost of $2.50 per gallon, yields annual savings of $437.5 million. This is an increase from the $130 million low and $391 million high, estimates of potential fuel savings from the original 2004 report. Note that this basic analysis does not assume any future changes in the cost of fuel. Note that this basic analysis does not assume any future changes in the cost of fuel. Given the level of uncertainty regarding future fuel prices and shipper reaction to any significant long-term changes, this is not an unreasonable assumption.

The AAR noted in its comments that "railroads today are using software programs that can calculate how to operate a train to minimize fuel consumption. It is by not means clear that PTC will be able to provide significant fuel savings above what the railroads will be able to achieve through other means." FRA, however, is convinced that there is a significant potential for fuel saving benefits to be realized from using PTC data to improve fuel consumption.

FRA also reviewed forecasts for diesel fuel prices developed by the Energy Information Administration (EIA). EIA price forecasts of diesel fuel are often relied on for analysis of motor vehicle fuel costs. The forecasts are based on several assumptions, and FRA will not analyze those assumptions here. However, were fuel prices to rise as significantly as EIA forecasts, the business benefit projections of implementing PTC would not be very meaningful, as underlying assumptions of modal diversion reflect relatively constant fuel prices and relative modal fuel efficiency. Were fuel prices to more than double in real terms, it is likely that much of today's highway freight would divert to rail, without regard to the reliability of rail delivery times due to the relative fuel efficiency of rail transportation. The relative impact of more reliable delivery on diversion would therefore be diminished significantly, and the remaining projections are not likely to be accurate. Further, were fuel prices to rise, railroads and highway motor carriers would strive to adopt more efficient technologies, as the relative value or return on investment of implementing those technologies would increase. This, in turn would reduce the available savings from train pacing and other PTC related fuel savings and possibly alter the relative rail-truck fuel efficiency. Nevertheless, as a measure of sensitivity, FRA did analyze the impact of fuel prices rising in line with EIA forecasts, all else constant. FRA arrived at a railroad fuel price by subtracting $0.224 per gallon from forecasted EIA diesel fuel prices to reflect that railroads do not pay the high fuel tax that highway vehicles pay. FRA also notes that fuel taxes are transfer payments, not societal costs, and are not appropriate for inclusion in an analysis of societal costs. The impact on fuel consumption savings, assuming nothing else were to change in the FRA business benefits model, would be additional savings of approximately $2.5 billion over twenty years. Table A-1 details annual impacts:

Table A-1

	Normal Price	Estimated Railroad Price	Difference From Appendix A	Benefit Difference 3.5 billion Gallons	Discount Rate 7% Discount Factor	Discounted Difference	Discount Rate 3% Discount Factor	Discounted Difference
2006	2.713	2.489	0.0					
2007	2.870	2.646	0.146					
2008	3.795	3.571	1.071					
2009	2.178	1.954	-0.546		1.00		1.00	
2010	2.082	1.858	-0.642		0.93		0.97	
2011	2.458	2.234	-0.266		0.87		0.94	
2012	2.754	2.530	0.030		0.82		0.92	
2013	3.116	2.892	0.392		0.76		0.89	
2014	3.391	3.167	0.667		0.71		0.86	
2015	3.623	3.399	0.899		0.67		0.84	
2016	3.840	3.616	1.116		0.62		0.81	
2017	4.074	3.850	1.350	$23,633,026	0.58	$13,754,636	0.79	$18,656,129
2018	4.283	4.059	1.559	$54,580,580	0.54	$29,688,219	0.77	$41,831,469
2019	4.460	4.236	1.736	$121,486,397	0.51	$61,757,524	0.74	$90,397,289
2020	4.627	4.403	1.903	$199,791,108	0.48	$94,919,316	0.72	$144,333,348
2021	4.726	4.502	2.002	$297,840,634	0.44	$132,244,804	0.70	$208,899,428
2022	4.891	4.667	2.167	$379,223,462	0.41	$157,364,254	0.68	$258,232,725
2023	5.054	4.830	2.330	$407,812,794	0.39	$158,156,833	0.66	$269,612,300
2024	5.173	4.949	2.449	$428,533,429	0.36	$155,320,236	0.64	$275,059,301
2025	5.281	5.057	2.557	$447,551,755	0.34	$151,601,264	0.62	$278,899,457
2026	5.455	5.231	2.731	$478,007,886	0.32	$151,325,055	0.61	$289,202,632
2027	5.541	5.317	2.817	$492,923,581	0.30	$145,838,301	0.59	$289,540,653
2028	5.753	5.529	3.029	$530,011,533	0.28	$146,552,605	0.57	$302,258,171
					Total	$1,398,523,047	Total	$2,466,922,902

Source: Report #:DOE/EIA-0383(2009)

The fourth and most complex modification was to the approach taken in the 2004 report to address modal diversion. The 2004 report estimated benefits derived from diversion from highway to rail. These benefits resulted from changes in shipper behavior in response to productivity increases experienced by shippers when using rail. The 2004 report estimated the productivity benefits to shippers under PTC B, which is most similar to the required PTC systems. The productivity benefit estimates were kept constant in the 2004 study and FRA has kept that assumption here, although it is reasonable, but less conservative, to assume that the productivity benefits will increase over time as shippers have time to modify their physical plants to take greater advantage of productivity enhancements on the railroads. The indirect business and safety benefits presented in the 2004 report increased over time, due to increased costs of congestion on the highway systems resulting increased modal diversion in terms of volume and value per ton mile over time.

The 2004 report estimated diversion for two different years, 2010, and 2020. The earlier year was to have been around the time the full PTC system could have been deployed, under the most optimistic assumptions. The report presented high and low benefits estimates. For the current analysis, FRA assumes that the indirect benefits to society are a result of productivity benefits to shippers and that these indirect benefits would be in proportion to shipper productivity benefits. Similarly, the ratio of indirect benefits to shipper cost impacts would remain constant over time. According to the 2004 report, the 2010 ratio of indirect benefits to shipper productivity was 1.02

for the low benefit estimate, and 0.86 for the high benefit estimate. FRA averaged these two numbers to arrive at an estimate of 0.94. The 2020 ratio of indirect benefits to shipper productivity was 1.57 for the low benefit estimate, and 1.32 for the high benefit estimate. FRA averaged these two numbers to arrive at an estimate of 1.45. FRA then estimated the average annual growth rate that would be needed to grow from .94 in 2010 to 1.45 in 2020 (the tenth root of 1.45/0.94), and used that rate to estimate the diversion impact relative to shipper costs in every year of the analysis period. See Table A-2

Table A-2

Indirect Benefit Phase In

Year	Percent
2009	90.01%
2010	94.00%
2011	98.16%
2012	102.51%
2013	107.05%
2014	111.80%
2015	116.75%
2016	121.92%
2017	127.32%
2018	132.96%
2019	138.85%
2020	145.00%
2021	151.42%
2022	158.13%
2023	165.14%
2024	172.45%
2025	180.09%
2026	188.07%
2027	196.40%
2028	205.10%

The 2004 report did not consider how PTC would be funded. The benefits were analyzed as if the system had been donated to the railroads. Based on the current environment and the focus of this analysis on business benefits to Class I railroads, this analysis is based on the assumption that the railroads will purchase PTC systems. If the railroads pass on savings from their productivity savings to shippers, then that implies that there is a price elasticity that will enable the railroads to pass on costs as well. If FRA is going to say that an increase in benefit to shippers will induce them to ship more by rail, then a cost increase to shippers will induce them to ship less by rail. FRA estimates the diversion caused by the portion of total railroad costs passed on to shippers, as a cost, as well as the diversion caused by shipper benefits, as a benefit. FRA estimates that 80% of railroad benefits or costs are passed on to shippers. The annual costs of PTC are derived from

Tables 4a and 4b in the primary analysis above. FRA did not estimate business benefits for the high and low cost cases, only the expected cost case. See Tables A-3 and A-4.

The last major adjustment FRA made to the values in the 2004 report was to eliminate any benefit attributable to locomotive diagnostics, as FRA now believes those benefits have already been captured by other technologies in the absence of PTC.

The PTC systems that railroads are planning for purposes of complying with RSIA08 and the final rule do not have features built in to enhance productivity, but such features could be added without facing the large economic hurdle that existed prior to RSIA08, when the railroads contemplating whether to install PTC and productivity enhancing systems would have had to develop business cases for spending the entire cost of PTC, estimated in the main analysis at $5.7 billion, plus the added productivity system cost. If PTC costs are sunk costs[1], then the railroads only need to consider the marginal costs above PTC of adding productivity systems. These systems include fuel management systems that have onboard and central office components and precision dispatching systems that take advantage of train location data generated by the PTC system. A large railroad procured an entire dispatch system for roughly $50 million less than ten years ago. It is reasonable to believe that all seven Class I railroads could procure productivity enhancing systems for around $150 million today, since the systems would be add-ons to existing dispatch and onboard systems. For purposes of this analysis, FRA assumes that productivity systems would cost $150 million. Over the twenty year analysis period, at the discount rate of 3%, the Net Present Value (NPV) of the maintenance costs would be $148 million, for a total NPV over the analysis period of $298 million, which is far less than the $13.8 billion NPV of business benefits. Clearly, the investment would be justified. The gap between the costs and benefits is so large that even a large variance in costs would not affect the positive outcome of the analysis.

In Tables A-4 and A-5, Costs to Shippers (the portion of PTC implementation costs passed on by railroads) are derived by multiplying annual costs from Tables 4a and 4b by 80%. Annual indirect costs to society are derived by multiplying Costs to Shippers presented in Tables A-4 and A-5 by the percentages from Table A-2 (the multipliers used to translate increases/decreases in shipper productivity to increases/decreases in societal benefits from modal diversion). Productivity or Add-On system costs are based on a cost estimate of $150 million and an annual phase in of 20%, starting in 2016. The Installed Productivity System represents the part of the productivity system that has been installed through the end of the previous year. Productivity Maintenance Costs are the annual maintenance cost, which are 15% of the Installed Productivity System cost already incurred. The Productivity Benefit is the steady state annual productivity benefit, derived from the 2004 report, $1,265,805,000, multiplied by a business benefit phase-in factor assumed by FRA. See Table A-3, below. FRA derived the $1,265,805,000 productivity benefit by averaging PTC B shipper direct benefits from the 2004 report ($900 million and $1.4 billion for low and high estimates, respectively) to get $1.15 Billion, and then multiplying that number by the GDP deflator, 1.1007.

FRA followed a similar process to derive Other Direct Benefits, in Tables A-4 – A-5. FRA averaged inflated low and high Direct Benefits from the 2004 report, using the GDP deflator[2], and

[1] Costs that have already been incurred and cannot be reversed.
[2] Low and high benefits of $1,933,310,740 and $3,057,925,253 were inflated by a factor of 1.1007 to arrive at low and

is using the average, $2,746,022,666, as the estimate of total direct benefits. Total direct benefits included shipper direct benefits, so to calculate Other Direct Benefits, FRA subtracted the $1,265,805,000 of Shipper Direct Benefits from $2,746,022,666 and arrived at an Other Direct Benefits estimate of $1,481,022,666 per year. These benefits were also phased in using the values in Table A-3.

Table A-3

Business Benefit
Phase In

Year	Percent
2017	10.00%
2018	20.00%
2019	40.00%
2020	60.00%
2021	85.00%
2022	100.00%

As discussed above, FRA believes that favorable diversion impacts will increase over time relative to shipper impacts because the value of alleviating highway congestion will increase per ton mile as highways get more congested. FRA calculated the Indirect Benefit by multiplying the Productivity Benefit by the annual factors from Table A-2.

FRA next calculated the Annual Business Net impact, which is the difference between the sum of the Productivity Benefit, the Other Direct Benefit, and the Indirect Benefit, and the sum of the Indirect Costs, the Productivity System Costs, and the Productivity Maintenance Costs. Note that Costs to Shippers is a transfer payment to railroads, and is not included in business costs. This cost is used to derive other costs, which are included. Negative values represent net societal costs and positive values represent net societal benefits.

Tables A4 – A-5 also present Discounted Annual Business Net impact as well as total 20-year Discounted Business Net impact. Net benefits total $ 6,298,115,853 discounted at 7%, and $14,065,184,853, discounted at 3%. Discounted at 3% the net business-related benefit is large enough, that coupled with the safety benefits from Table 4b, the benefits would exceed the costs of PTC implementation with productivity enhancing add-ons. Discounted at 7%, the net business-related benefits would not be large enough to offset the costs. However, extending the analysis to twenty five years allows the Discounted Net Business Impact to reach $10,948,290,412 (NPV 7%) and the Discounted Railroad Safety Benefit to reach $513,533,166, which together would exceed Discounted PTC System Total Costs, which would grow to $10,753,644,578. Thus, over a 25-year period using a 7% discount factor, net discounted benefits would exceed the net discounted costs (See Table A-6). Table A-7 presents a 25-year analysis using a 3% discount rate.

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high benefits of $2,127,797,005 and $3,366,858,326 in current dollars. The average of these two values is $1,265,805,000.

The 2004 report notes that reductions in highway accident costs comprise 81.1188% of indirect benefits. FRA derived the Net Highway Accident Impact associated with the PTC productivity add-on implementation in this analysis by subtracting Indirect Costs from Indirect Benefits, and multiplying the result by 81.1188%. FRA also calculated Discounted Net Highway Accident Impact using both 3% and 7% discount rates. In this analysis, the early expenditures on PTC system implementation in response to RSIA08 and the final rule cause significant adverse cost impact in the early years. It is not until later years, when productivity-enhancing systems come on line, that the net impact becomes beneficial. If productivity-enhancing systems fail to materialize, then the net impact of PTC system implementation would be adverse as is portrayed in the primary analysis. An interesting implication of the model presented in this appendix is that finding a way to move costs from early years to later years, perhaps through financing, could provide a significant reduction in the adverse diversion impacts. Smoothing out the expenditures would result in fewer negative impacts to shippers and thus fewer costs passed on to society in the years before the positive impacts are realized.

Another implication of this analysis is that installing the productivity systems earlier would dramatically improve the time until the system breaks even. Tables A-8 and A-9 show the impact of installing the productivity systems two years earlier.

Table A-4

Discount Rate 7% Year	Costs to Shippers	Indirect Costs	Productivity System Costs	Installed Productivity System	Productivity Maintenance Costs	Productivity Benefit	Other Direct Benefit	Indirect Benefit	Annual Business Net	Discounted Annual Business Net	Net Highway Accident Impact	Discounted Net Highway Accident Impact
2009	$ 48,000,000	$ 43,206,101	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 43,206,101	-$ 43,206,101	-$35,048,271	-$35,048,271
2010	$ 55,200,000	$ 51,888,000	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 51,888,000	-$ 48,493,458	-$42,090,923	-$39,337,311
2011	$ 485,643,789	$ 476,726,954	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 476,726,954	-$ 416,391,784	-$386,715,184	-$337,772,019
2012	$ 689,254,146	$ 706,570,125	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 706,570,125	-$ 576,771,693	-$573,161,206	-$467,870,276
2013	$ 912,803,072	$ 977,185,448	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 977,185,448	-$ 745,490,100	-$792,681,109	-$604,732,623
2014	$1,374,138,143	$ 1,536,223,159	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$1,536,223,159	-$ 1,095,305,881	-$1,246,165,792	-$888,498,987
2015	$1,803,165,131	$ 2,105,151,852	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$2,105,151,852	-$ 1,402,751,567	-$1,707,673,921	-$1,137,895,238
2016	$ 652,511,367	$ 795,536,342	$ 30,000,000	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 825,536,342	-$ 514,102,544	-$645,329,534	-$401,878,801
2017	$ 652,511,367	$ 830,776,186	$ 30,000,000	$ 30,000,000	$ 4,500,000	$ 126,580,500	$ 148,102,267	$ 161,162,043	-$ 429,431,376	-$ 249,932,971	-$543,182,957	-$316,137,427
2018	$ 652,511,367	$ 867,577,048	$ 30,000,000	$ 60,000,000	$ 9,000,000	$ 253,161,000	$ 296,204,533	$ 336,602,064	-$ 20,609,450	-$ 11,210,175	-$430,720,535	-$234,283,433
2019	$ 652,511,367	$ 906,008,076	$ 30,000,000	$ 90,000,000	$ 13,500,000	$ 506,322,000	$ 592,409,066	$ 703,025,027	$ 852,248,017	$ 433,239,676	-$164,657,414	-$83,703,480
2020	$ 652,511,367	$ 946,141,482	$ 30,000,000	$ 120,000,000	$ 18,000,000	$ 759,483,000	$ 888,613,600	$ 1,101,250,350	$ 1,755,205,468	$ 833,885,474	$125,822,453	$59,777,341
2021	$ 652,511,367	$ 988,052,676	$ 0	$ 150,000,000	$ 22,500,000	$ 1,075,934,250	$ 1,258,869,266	$ 1,629,212,560	$ 2,953,463,401	$ 1,311,373,071	$520,101,205	$230,931,155
2022	$ 652,511,367	$ 1,031,820,408	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,001,625,563	$ 3,694,132,821	$ 1,532,933,786	$786,694,304	$326,450,167
2023	$ 652,511,367	$ 1,077,526,918	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,090,291,496	$ 3,737,092,244	$ 1,449,308,803	$821,542,472	$318,608,335
2024	$ 652,511,367	$ 1,125,258,088	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,182,885,060	$ 3,781,954,638	$ 1,370,754,405	$857,934,308	$310,954,875
2025	$ 652,511,367	$ 1,175,103,603	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,279,580,238	$ 3,828,804,301	$ 1,296,948,485	$895,938,192	$303,485,263
2026	$ 652,511,367	$ 1,227,157,124	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,380,558,719	$ 3,877,729,261	$ 1,227,589,777	$935,625,533	$296,195,083
2027	$ 652,511,367	$ 1,281,516,457	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,486,010,240	$ 3,928,821,448	$ 1,162,396,500	$977,070,902	$289,080,024
2028	$ 652,511,367	$ 1,338,283,744	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,596,132,942	$ 3,982,176,865	$ 1,101,105,087	$1,020,352,176	$282,135,879
										$ 6,615,878,792		-$2,129,539,742

Table A-5

Discount Rate: 3%

Year	Costs to Shippers	Indirect Costs	Productivity System Costs	Installed Productivity System	Productivity Maintenance Costs	Productivity Benefit	Other Direct Benefit	Indirect Benefit	Annual Business Net	Discounted Annual Business Net	Net Highway Accident Impact	Discounted Net Highway Accident Impact
2009	$ 48,000,000	$ 43,206,101	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 43,206,101	-$ 43,206,101	-$35,048,271	-$35,048,271
2010	$ 55,200,000	$ 51,888,000	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 51,888,000	-$ 50,376,699	-$42,090,923	-$40,864,974
2011	$ 485,643,789	$ 476,726,954	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 476,726,954	-$ 449,360,876	-$386,715,184	-$364,516,151
2012	$ 689,254,146	$ 706,570,125	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 706,570,125	-$ 646,611,756	-$573,161,206	-$524,523,697
2013	$ 912,803,072	$ 977,185,448	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 977,185,448	-$ 868,216,614	-$792,681,109	-$704,286,899
2014	$1,374,138,143	$1,536,223,159	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 1,536,223,159	-$ 1,325,159,592	-$1,246,165,792	-$1,074,953,559
2015	$1,803,165,131	$2,105,151,852	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 2,105,151,852	-$ 1,763,031,534	-$1,707,673,921	-$1,430,150,024
2016	$ 652,511,367	$ 795,536,342	$30,000,000	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 825,536,342	-$ 671,236,592	-$645,329,534	-$524,711,967
2017	$ 652,511,367	$ 830,776,186	$30,000,000	$ 30,000,000	$ 4,500,000	$ 126,580,500	$ 148,102,267	$ 161,162,043	-$ 429,431,376	-$ 338,997,094	-$543,182,957	-$428,793,642
2018	$ 652,511,367	$ 867,577,048	$30,000,000	$ 60,000,000	$ 9,000,000	$ 253,161,000	$ 296,204,533	$ 336,602,064	-$ 20,609,450	-$ 15,795,428	-$430,720,535	-$330,111,425
2019	$ 652,511,367	$ 906,008,076	$30,000,000	$ 90,000,000	$ 13,500,000	$ 506,322,000	$ 592,409,066	$ 703,025,027	$ 852,248,017	$ 634,152,564	-$164,657,414	-$122,520,580
2020	$ 652,511,367	$ 946,141,482	$30,000,000	$ 120,000,000	$ 18,000,000	$ 759,483,000	$ 888,613,600	$ 1,101,250,350	$ 1,755,205,468	$ 1,267,997,775	$125,822,453	$90,896,817
2021	$ 652,511,367	$ 988,052,676	$ 0	$ 150,000,000	$ 22,500,000	$ 1,075,934,250	$ 1,258,869,266	$ 1,629,212,560	$ 2,953,463,401	$ 2,071,499,806	$520,101,205	$364,788,521
2022	$ 652,511,367	$1,031,820,408	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,001,625,563	$ 3,694,132,821	$ 2,515,524,694	$786,694,304	$535,700,540
2023	$ 652,511,367	$1,077,526,918	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,090,291,496	$ 3,737,092,244	$ 2,470,658,224	$821,542,472	$543,136,357
2024	$ 652,511,367	$1,125,258,088	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,182,885,060	$ 3,781,954,638	$ 2,427,492,769	$857,934,308	$550,675,386
2025	$ 652,511,367	$1,175,103,603	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,279,580,238	$ 3,828,804,301	$ 2,385,984,257	$895,938,192	$558,319,061
2026	$ 652,511,367	$1,227,157,124	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,380,558,719	$ 3,877,729,261	$ 2,346,089,975	$935,625,533	$566,068,835
2027	$ 652,511,367	$1,281,516,457	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,486,010,240	$ 3,928,821,448	$ 2,307,768,533	$977,070,902	$573,926,179
2028	$ 652,511,367	$1,338,283,744	$ 0	$ 150,000,000	$ 22,500,000	$ 1,265,805,000	$ 1,481,022,666	$ 2,596,132,942	$ 3,982,176,865	$ 2,270,979,822	$1,020,352,176	$581,892,588
										$ 14,526,156,133		-$ 1,215,076,904

A-6 (25-Year Analysis)

7% Year	Costs to Shippers	Indirect Costs	Productivity System Costs	Installed Productivity System	Productivity Maintenance Costs	Productivity Benefit	Other Direct Benefit	Indirect Benefit	Annual Business Net	Annual Business Net	Highway Accident Impact	Highway Accident Impact	Cumulative Net Benefit
2009	$ 48,000,000	$ 43,206,101	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$43,206,101	-$ 43,206,101	-$35,048,271	-$35,048,271	-$ 103,206,101
2010	$ 55,200,000	$ 51,888,000	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$51,888,000	-$ 48,493,458	-$42,090,923	-$39,337,311	-$ 216,185,540
2011	$ 485,643,789	$ 476,726,954	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$476,726,954	-$ 416,391,784	-$386,715,184	-$337,772,019	-$ 1,161,096,121
2012	$ 689,254,146	$ 706,570,125	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$706,570,125	-$ 576,771,693	-$573,161,206	-$467,870,276	-$ 2,435,848,046
2013	$ 912,803,072	$ 977,185,448	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$977,185,448	-$ 745,490,100	-$792,681,109	-$604,732,623	-$ 4,041,868,739
2014	$1,374,138,143	$ 1,536,223,159	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$1,536,223,159	-$1,095,305,881	-$1,246,165,792	-$888,498,987	-$ 6,338,637,080
2015	$1,803,165,131	$ 2,105,151,852	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$2,105,151,852	-$1,402,751,567	-$1,707,673,921	-$1,137,895,238	-$ 9,206,412,250
2016	$ 652,511,367	$ 795,536,342	$30,000,000	$ 0	$ 0	$ 0	$ 0	$ 0	-$825,536,342	-$ 514,102,544	-$645,329,534	-$401,878,801	-$10,187,901,151
2017	$ 652,511,367	$ 830,776,186	$30,000,000	$30,000,000	$4,500,000	$ 126,580,500	$ 148,102,267	$ 161,162,043	-$429,431,376	-$ 249,932,971	-$543,182,957	-$316,137,427	-$10,874,643,801
2018	$ 652,511,367	$ 867,577,048	$30,000,000	$60,000,000	$9,000,000	$ 253,161,000	$ 296,204,533	$ 336,602,064	-$20,609,450	-$ 11,210,175	-$430,720,535	-$234,283,433	-$11,294,087,322
2019	$ 652,511,367	$ 906,008,076	$30,000,000	$90,000,000	$13,500,000	$ 506,322,000	$ 592,409,066	$ 703,025,027	$852,248,017	$ 433,239,676	-$164,657,414	-$83,703,480	-$11,242,374,136
2020	$ 652,511,367	$ 946,141,482	$30,000,000	$120,000,000	$18,000,000	$ 759,483,000	$ 888,613,600	$ 1,101,250,350	$1,755,205,468	$ 833,885,474	$125,822,453	$59,777,341	-$10,765,055,476
2021	$ 652,511,367	$ 988,052,676	$ 0	$150,000,000	$22,500,000	$1,075,934,250	$ 1,258,869,266	$ 1,629,212,560	$2,953,463,401	$1,311,373,071	$520,101,205	$230,931,155	-$ 9,786,922,418
2022	$ 652,511,367	$ 1,031,820,408	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,001,625,563	$3,694,132,821	$1,532,933,786	$786,694,304	$326,450,167	-$ 8,565,427,896
2023	$ 652,511,367	$ 1,077,526,918	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,090,291,496	$3,737,092,244	$1,449,308,803	$821,542,472	$318,608,335	-$ 7,407,183,825
2024	$ 652,511,367	$ 1,125,258,088	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,182,885,060	$3,781,954,638	$1,370,754,405	$857,934,308	$310,954,875	-$ 6,308,452,535
2025	$ 652,511,367	$ 1,175,103,603	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,279,580,238	$3,828,804,301	$1,296,948,485	$895,938,192	$303,485,263	-$ 5,265,731,261
2026	$ 652,511,367	$ 1,227,157,124	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,380,558,719	$3,877,729,261	$1,227,589,777	$935,625,533	$296,195,083	-$ 4,275,737,007
2027	$ 652,511,367	$ 1,281,516,457	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,486,010,240	$3,928,821,448	$1,162,396,500	$977,070,902	$289,080,024	-$ 3,335,392,398
2028	$ 652,511,367	$ 1,338,283,744	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,596,132,942	$3,982,176,865	$1,101,105,087	$1,020,352,176	$282,135,879	-$ 2,441,812,444
2029	$ 652,511,367	$ 1,397,565,649	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,711,133,746	$4,037,895,764	$1,043,468,997	$1,065,550,678	$275,358,544	-$ 1,592,292,168
2030	$ 652,511,367	$ 1,459,473,562	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,831,228,737	$4,096,082,840	$ 989,257,610	$1,112,751,336	$268,744,010	-$ 784,295,045
2031	$ 652,511,367	$ 1,524,123,808	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$ 1,481,022,666	$ 2,956,643,570	$4,156,847,428	$ 938,255,190	$1,162,042,841	$262,288,368	-$ 15,442,180
2032	$ 652,511,367	$ 1,591,637,864	$ 0	$150,000,00	$22,500,000	$1,265,805,00	$ 1,481,022,666	$ 3,087,613,900	$4,220,303,703	$ 890,259,913	$1,213,517,809	$255,987,800	$ 716,497,803

				0		0							
2033	$ 652,511,367	$ 1,662,142,587	$ 0	$150,000,00 0	$22,500,000	$1,265,805,00 0	$ 1,481,022,666	$ 3,224,385,818	$4,286,570,897	$ 845,082,964 $ 11,322,203,465	$1,267,272,962	$249,838,581 -$817,322,440	$ 1,413,618,216

Table A-7

Discount Rate

3.00%

Year	Costs to Shippers	Indirect Costs	Productivity System Costs	Installed Productivity System	Productivity Maintenance Costs	Productivity Benefit	Other Direct Benefit	Indirect Benefit	Annual Business Net	Discounted Annual Business Net	Net Highway Accident Impact	Discounted Net Highway Accident Impact	Cumulative Net Benefit
2009	$ 48,000,000	$ 43,206,101	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 43,206,101	-$ 43,206,101	-$35,048,271	-$35,048,271	-$ 103,206,101
2010	$ 55,200,000	$ 51,888,000	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 51,888,000	-$ 50,376,699	-$42,090,923	-$40,864,974	-$ 220,573,091
2011	$ 485,643,789	$ 476,726,954	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 476,726,954	-$ 449,360,876	-$386,715,184	-$364,516,151	-$ 1,240,299,855
2012	$ 689,254,146	$ 706,570,125	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 706,570,125	-$ 646,611,756	-$573,161,206	-$524,523,697	-$ 2,669,408,793
2013	$ 912,803,072	$ 977,185,448	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 977,185,448	-$ 868,216,614	-$792,681,109	-$704,286,899	-$ 4,539,821,089
2014	$1,374,138,143	$1,536,223,159	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$1,536,223,159	-$ 1,325,159,592	-$1,246,165,792	-$1,074,953,559	-$ 7,318,574,174
2015	$1,803,165,131	$2,105,151,852	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$2,105,151,852	-$ 1,763,031,534	-$1,707,673,921	-$1,430,150,024	-$ 10,922,903,108
2016	$ 652,511,367	$ 795,536,342	$30,000,000	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 825,536,342	-$ 671,236,592	-$645,329,534	-$524,711,967	-$ 12,204,381,429
2017	$ 652,511,367	$ 830,776,186	$30,000,000	$ 30,000,000	$ 4,500,000	$ 126,580,500	$ 148,102,267	$ 161,162,043	-$ 429,431,376	-$ 338,997,094	-$543,182,957	-$428,793,642	-$ 13,135,846,221
2018	$ 652,511,367	$ 867,577,048	$30,000,000	$ 60,000,000	$ 9,000,000	$ 253,161,000	$ 296,204,533	$ 336,602,064	-$ 20,609,450	-$ 15,795,428	-$430,720,535	-$330,111,425	-$ 13,726,853,006
2019	$ 652,511,367	$ 906,008,076	$30,000,000	$ 90,000,000	$ 13,500,000	$ 506,322,000	$ 592,409,066	$ 703,025,027	$ 852,248,017	$ 634,152,564	-$164,657,414	-$122,520,580	-$ 13,651,158,071
2020	$ 652,511,367	$ 946,141,482	$30,000,000	$ 120,000,000	$ 18,000,000	$ 759,483,000	$ 888,613,600	$ 1,101,250,350	$1,755,205,468	$ 1,267,997,775	$125,822,453	$90,896,817	-$ 12,925,352,168
2021	$ 652,511,367	$ 988,052,676	$ 0	$ 150,000,000	$ 22,500,000	$1,075,934,250	$1,258,869,266	$ 1,629,212,560	$2,953,463,401	$ 2,071,499,806	$520,101,205	$364,788,521	-$ 11,380,252,238
2022	$ 652,511,367	$1,031,820,408	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,001,625,563	$3,694,132,821	$ 2,515,524,694	$786,694,304	$535,700,540	-$ 9,375,795,384
2023	$ 652,511,367	$1,077,526,918	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,090,291,496	$3,737,092,244	$ 2,470,658,224	$821,542,472	$543,136,357	-$ 7,401,319,530
2024	$ 652,511,367	$1,125,258,088	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,182,885,060	$3,781,954,638	$ 2,427,492,769	$857,934,308	$550,675,386	-$ 5,455,557,217
2025	$ 652,511,367	$1,175,103,603	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,279,580,238	$3,828,804,301	$ 2,385,984,257	$895,938,192	$558,319,061	-$ 3,537,272,432
2026	$ 652,511,367	$1,227,157,124	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,380,558,719	$3,877,729,261	$ 2,346,089,975	$935,625,533	$566,068,835	-$ 1,645,259,614
2027	$ 652,511,367	$1,281,516,457	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,486,010,240	$3,928,821,448	$ 2,307,768,533	$977,070,902	$573,926,179	$ 221,657,311
2028	$ 652,511,367	$1,338,283,744	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,596,132,942	$3,982,176,865	$ 2,270,979,822	$1,020,352,176	$581,892,588	$ 2,064,625,862

2029	$ 652,511,367	$1,397,565,649	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,711,133,746	$4,037,895,764	$ 2,235,684,982	$1,065,550,678	$589,969,575	$ 3,884,765,921
2030	$ 652,511,367	$1,459,473,562	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,831,228,737	$4,096,082,840	$ 2,201,846,365	$1,112,751,336	$598,158,675	$ 5,683,170,613
2031	$ 652,511,367	$1,524,123,808	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 2,956,643,570	$4,156,847,428	$ 2,169,427,500	$1,162,042,841	$606,461,444	$ 7,460,907,169
2032	$ 652,511,367	$1,591,637,864	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 3,087,613,900	$4,220,303,703	$ 2,138,393,062	$1,213,517,809	$614,879,461	$ 9,219,017,760
2033	$ 652,511,367	$1,662,142,587	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$ 3,224,385,818	$4,286,570,897	$ 2,108,708,838	$1,267,272,962	$623,414,323	$ 10,958,520,316
										$25,380,216,880		$1,817,806,575	

Table A-8

Discount Rate 7%

Year	Costs to Shippers	Indirect Costs	Productivity System Costs	Installed Productivity System	Productivity Maintenance Costs	Productivity Benefit	Other Direct Benefit	Indirect Benefit	Annual Business Net	Discounted Annual Business Net	Net Highway Accident Impact	Discounted Net Highway Accident Impact	Cumulative Net Benefit
2009	$ 48,000,000	$ 43,206,101	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 43,206,101	-$ 43,206,101	-$35,048,271	-$35,048,271	-$ 103,206,101
2010	$ 55,200,000	$ 51,888,000	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 51,888,000	-$ 48,493,458	-$42,090,923	-$39,337,311	-$ 216,185,540
2011	$ 485,643,789	$ 476,726,954	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 476,726,954	-$ 416,391,784	-$386,715,184	-$337,772,019	-$ 1,161,096,121
2012	$ 689,254,146	$ 706,570,125	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 706,570,125	-$ 576,771,693	-$573,161,206	-$467,870,276	-$ 2,435,848,046
2013	$ 912,803,072	$ 977,185,448	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 977,185,448	-$ 745,490,100	-$792,681,109	-$604,732,623	-$ 4,041,868,739
2014	$1,374,138,143	$1,536,223,159	$30,000,000	$ 0	$ 0	$ 0	$ 0	$ 0	-$1,566,223,159	-$1,116,695,467	-$1,246,165,792	-$888,498,987	-$ 6,360,026,665
2015	$1,803,165,131	$2,105,151,852	$30,000,000	$ 30,000,000	$ 4,500,000	$ 126,580,500	$ 148,102,267	$ 147,779,684	-$1,717,189,401	-$1,144,235,804	-$1,587,796,814	-$1,058,016,060	-$ 8,969,286,073
2016	$ 652,511,367	$ 795,536,342	$30,000,000	$ 60,000,000	$ 9,000,000	$ 253,161,000	$ 296,204,533	$ 308,651,751	$ 23,480,942	$ 14,622,751	-$394,954,938	-$245,958,086	-$ 9,422,049,679
2017	$ 652,511,367	$ 830,776,186	$30,000,000	$ 90,000,000	$ 13,500,000	$ 506,322,000	$ 592,409,066	$ 644,648,172	$ 869,103,053	$ 505,825,890	-$150,984,811	-$87,874,535	-$ 9,353,033,469
2018	$ 652,511,367	$ 867,577,048	$30,000,000	$ 120,000,000	$ 18,000,000	$ 759,483,000	$ 888,613,600	$1,009,806,193	$1,742,325,745	$ 947,709,763	$115,374,576	$62,756,125	-$ 8,813,557,051
2019	$ 652,511,367	$ 906,008,076	$ 0	$ 150,000,000	$ 22,500,000	$1,075,934,250	$1,258,869,266	$1,493,928,182	$2,900,223,622	$1,474,326,625	$476,913,735	$242,438,759	-$ 7,720,756,917
2020	$ 652,511,367	$ 946,141,482	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$1,835,417,250	$3,613,603,434	$1,716,796,961	$721,369,832	$342,717,611	-$ 6,360,526,770
2021	$ 652,511,367	$ 988,052,676	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$1,916,720,659	$3,652,995,650	$1,621,973,756	$753,324,324	$334,485,009	-$ 5,071,793,027
2022	$ 652,511,367	$1,031,820,408	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$2,001,625,563	$3,694,132,821	$1,532,933,786	$786,694,304	$326,450,167	-$ 3,850,298,505

2023	$ 652,511,367	$1,077,526,918	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$2,090,291,496	$3,737,092,244	$1,449,308,803	$821,542,472	$318,608,335	-$ 2,692,054,435
2024	$ 652,511,367	$1,125,258,088	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$2,182,885,060	$3,781,954,638	$1,370,754,405	$857,934,308	$310,954,875	-$ 1,593,323,145
2025	$ 652,511,367	$1,175,103,603	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$2,279,580,238	$3,828,804,301	$1,296,948,485	$895,938,192	$303,485,263	-$ 550,601,870
2026	$ 652,511,367	$1,227,157,124	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$2,380,558,719	$3,877,729,261	$1,227,589,777	$935,625,533	$296,195,083	$ 439,392,383
2027	$ 652,511,367	$1,281,516,457	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$2,486,010,240	$3,928,821,448	$1,162,396,500	$977,070,902	$289,080,024	$ 1,379,736,992
2028	$ 652,511,367	$1,338,283,744	$ 0	$ 150,000,000	$ 22,500,000	$1,265,805,000	$1,481,022,666	$2,596,132,942	$3,982,176,865	$1,101,105,087	$1,020,352,176	$282,135,879	$ 2,273,316,947
											$ 11,331,008,182	-$655,801,036	

Table A-9

Discount Rate

3.00%

Year	Costs to Shippers	Indirect Costs	Productivity System Costs	Installed Productivity System	Productivity Maintenance Costs	Productivity Benefit	Other Direct Benefit	Indirect Benefit	Annual Business Net	Discounted Annual Business Net	Net Highway Accident Impact	Discounted Net Highway Accident Impact	Cumulative Net Benefit
2009	$ 48,000,000	$ 43,206,101	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 43,206,101	-$ 43,206,101	-$35,048,271	-$35,048,271	-$ 103,206,101
2010	$ 55,200,000	$ 51,888,000	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 51,888,000	-$ 50,376,699	-$42,090,923	-$40,864,974	-$ 220,573,091
2011	$ 485,643,789	$ 476,726,954	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 476,726,954	-$ 449,360,876	-$386,715,184	-$364,516,151	-$ 1,240,299,855
2012	$ 689,254,146	$ 706,570,125	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 706,570,125	-$ 646,611,756	-$573,161,206	-$524,523,697	-$ 2,669,408,793
2013	$ 912,803,072	$ 977,185,448	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	-$ 977,185,448	-$ 868,216,614	-$792,681,109	-$704,286,899	-$ 4,539,821,089
2014	$1,374,138,143	$1,536,223,159	$30,000,000	$ 0	$ 0	$ 0	$ 0	$ 0	-$1,566,223,159	-$1,351,037,855	-$1,246,165,792	-$1,074,953,559	-$ 7,344,452,438
2015	$1,803,165,131	$2,105,151,852	$30,000,000	$30,000,000	$4,500,000	$ 126,580,500	$ 148,102,267	$ 147,779,684	-$1,717,189,401	-$1,438,119,089	-$1,587,796,814	-$1,329,754,835	-$10,623,868,926
2016	$ 652,511,367	$ 795,536,342	$30,000,000	$60,000,000	$9,000,000	$ 253,161,000	$ 296,204,533	$ 308,651,751	$ 23,480,942	$ 19,092,155	-$394,954,938	-$321,134,507	-$11,215,018,501
2017	$ 652,511,367	$ 830,776,186	$30,000,000	$90,000,000	$13,500,000	$ 506,322,000	$ 592,409,066	$ 644,648,172	$ 869,103,053	$ 686,077,975	-$150,984,811	-$119,188,804	-$11,121,408,223
2018	$ 652,511,367	$ 867,577,048	$30,000,000	$120,000,000	$18,000,000	$ 759,483,000	$ 888,613,600	$1,009,806,193	$1,742,325,745	$1,335,347,604	$115,374,576	$88,425,005	-$10,361,271,977
2019	$ 652,511,367	$ 906,008,076	$ 0	$150,000,000	$22,500,000	$1,075,934,250	$1,258,869,266	$1,493,928,182	$2,900,223,622	$2,158,038,749	$476,913,735	$354,868,608	-$ 8,761,690,856
2020	$ 652,511,367	$ 946,141,482	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$1,835,417,250	$3,613,603,434	$2,610,544,006	$721,369,832	$521,132,915	-$ 6,693,338,723
2021	$ 652,511,367	$ 988,052,676	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$1,916,720,659	$3,652,995,650	$2,562,137,651	$753,324,324	$528,366,524	-$ 4,657,600,947
2022	$ 652,511,367	$1,031,820,408	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$2,001,625,563	$3,694,132,821	$2,515,524,694	$786,694,304	$535,700,540	-$ 2,653,144,094
2023	$ 652,511,367	$1,077,526,918	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$2,090,291,496	$3,737,092,244	$2,470,658,224	$821,542,472	$543,136,357	-$ 678,668,239
2024	$ 652,511,367	$1,125,258,088	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$2,182,885,060	$3,781,954,638	$2,427,492,769	$857,934,308	$550,675,386	$ 1,267,094,074
2025	$ 652,511,367	$1,175,103,603	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$2,279,580,238	$3,828,804,301	$2,385,984,257	$895,938,192	$558,319,061	$ 3,185,378,859
2026	$ 652,511,367	$1,227,157,124	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$2,380,558,719	$3,877,729,261	$2,346,089,975	$935,625,533	$566,068,835	$ 5,077,391,677
2027	$ 652,511,367	$1,281,516,457	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$2,486,010,240	$3,928,821,448	$2,307,768,533	$977,070,902	$573,926,179	$ 6,944,308,601
2028	$ 652,511,367	$1,338,283,744	$ 0	$150,000,000	$22,500,000	$1,265,805,000	$1,481,022,666	$2,596,132,942	$3,982,176,865	$2,270,979,822	$1,020,352,176	$581,892,588	$ 8,787,277,152
										$21,248,807,424		$ 888,240,303	

Much of the preceding analysis depends on analysis conducted earlier and presented in the 2004 report, so it is important to introduce the key concepts from that report.

As part of a Congressionally mandated study of all costs and benefits of PTC, including business benefits, FRA had a contractor, Zeta-Tech Associates (Zeta-Tech), examine the business benefits and costs of PTC implementation. FRA combined that analysis with FRA estimates of modal diversion and societal consequences, and with findings from a joint effort between FRA and the Volpe Center (Volpe) to analyze potential accident cost reductions and additional societal benefits from implementing PTC.

FRA then conducted a peer review workshop to which representatives of railroads (freight and passenger), labor organizations, suppliers, and shippers were invited. Draft reports were presented, and post-workshop written filings were received.

Although there was significant disagreement over the FRA contractor's report, if the Zeta-Tech's analysis is correct then major benefits might arise from (1) improved railroad productivity; (2) resulting reductions in shipper logistical costs caused by faster, more reliable rail shipments, and (3) diversion of freight traffic from highway to rail. Adaptations made in order to conduct the present analysis are discussed throughout this appendix.

Zeta-Tech studied the costs, and found they were similar to those estimated by the RSAC in 1998-1999. However, according to peer reviewers, on-board systems were expected to be about one-third less expensive than previously estimated. In its analysis of the final rule, FRA is using higher costs for on-board systems because FRA believes the railroads are facing a very constrained market with the tight deadlines of RSIA08.

The 2004 report analyzed two levels of PTC, then called PTC A and PTC B, for purposes of analysis. In general, both the costs and benefits of PTC A were similar to, but smaller than the costs and benefits of PTC B. PTC B is more like the systems that will be installed under RSI08. Significant timing issues, which were not considered fully in that analysis, have impacted the use of the results in this analysis. The most significant timing issue is that PTC will take several years to deploy and the benefits, especially the business-related benefits, will not flow until the systems are substantially complete. In the 2004 report, FRA analyzed the effects on railroads using estimates based on year 2000 traffic flows, but the truck-to-rail diversion estimates that formed the basis for additional societal benefits were estimated for 2010, and 2020. This did not allow for any growth in traffic leading to conservative diversion estimates. Another timing issue is that the intermodal diversion projections were based on PTC having been in service for several years, yet a realistic timeline for systemwide adoption of PTC might not have had PTC in place before year 2010. In fact, FRA is not projecting full PTC deployment until the end of 2015, and FRA is not projecting full productivity benefits until 2022. Thus the level of productivity benefits presented for 2010 in the 2004 report are more likely reflective of Year 2022 under current circumstances.

The 2004 report did not definitively resolve whether, in order to realize any modal diversion, railroads would have to make additional investments in yard and terminal capacity to handle the additional traffic volume. If that were necessary, several hundred million dollars in additional investment might be required to realize improvements in rail service that generate the largest portion of the possible benefits, which come from productivity enhancements. Some additional highway and railroad investment might also be required to provide access to new or expanded intermodal terminals from the interstate highway system.

Finally, the 2004 report did not examine an issue that is critical for the success of PTC–the question of communications capacity. More sophisticated forms of PTC will require rapid flows of digital data. Developments in communications technology promise a rich set of options for addressing this need. However, to the extent a PTC system requires partial reliance on a commercial service, additional costs might be incurred. That is, the data communication backbone might not be available "free" for auxiliary business functions. FRA believes that the data needed to operate PTC is sufficient to add productivity benefits, and has accounted for communication costs in the main analysis of the final rule.

Key Elements of the Business Benefits

Work Order Reporting

The purpose of the work order system is to plan and schedule the work of train crews. However, it is not possible to schedule all work in advance, since it is impossible to perfectly predict future occurrences. However, the addition of unplanned work may mean delays to cars or train crews, since without advance knowledge of work to be done, crews may run out of time before completing all scheduled work and any unplanned work. Outbound connections in yards may also be missed if large volumes of additional work delay completion of a switching shift.

Work order reporting systems send instructions over the digital data link communications network from the control center to train crews regarding the setting out and picking up of loaded and empty cars enroute. When crews acknowledge accomplishment of work orders, the system automatically updates the on-board train consist information and transmits information on car location and train consists back over the digital data link communications network to the railroad's operating data system and to customers. Work order reporting information can be displayed in locomotives on the same screens that would display PTC instructions and information.

Real-time or near real-time information will reduce additional, unplanned work, by reducing the volume of inaccurate or out-of-date information used in the generation of work orders. The earlier there is knowledge of unplanned work the better the plan is able to accommodate that work without disruption of other elements of the plan. Since yard and industry switchers and local freights perform most additional work, the benefits resulting from a reduction in additional work will be realized mostly in these services. For this reason, the analysis presented here is confined to switchers and local freights. There simply do not seem to be large benefits to be realized from real-time reporting of train consist data and completed work by unit trains and through freight trains, because those trains do not undergo much switching activity.

Zeta-Tech estimated the benefits from work order reporting to be $10 million per year, under either PTC A or PTC B[1] the additional features of PTC B have nothing to do with collecting and

[1] *Quantification of the Business Benefits of Positive Train Control*, Zeta-Tech Associates, Cherry Hill, NJ, March 15,

disseminating information useful for work order reporting). The methodology used to derive these benefits focuses on the ability to process a rail car more rapidly through a terminal area, given better and more timely information about that car, and therefore to reduce the likelihood that the car will miss the next train leaving the yard for its destination. At present it does not appear, based on anecdotal information, that any Class I railroad has a work order reporting system that can provide these benefits without PTC, however, it also appears that such systems are under development.

The AAR, in its comments, said that these benefits were already being derived from other, non-PTC systems. (One of these, the UP work order reporting system, actually utilizes an ATCS communications platform.)

FRA recognizes that commercial wireless communications have become available that no longer make a train control communications platform a necessity. The widespread availability of commercial communications services offers an alternative means of realizing these benefits. Further, most major railroads now have car scheduling programs that address the same needs. The Automatic Equipment Identification (AEI) program provides data on cars passing fixed points throughout the national rail system. Accordingly, the extent to which work order reporting might be profitably employed in the future is not known, and FRA has not included any quantified benefit from this report. FRA does believe that a PTC communications platform could help hold down the cost of work order reporting.

Fuel Savings

PTC can let train operations be paced, so that trains do not operate at top speed for a short duration, only to wait for an extended period to acquire authority for the next track segment. A great deal of fuel could be wasted in accelerating from a stop, or from operating at unnecessarily high speeds.

FRA has described its estimation process for this value added above.

Precision Dispatch

Precision dispatching is dispatching based on very frequent updates of the positions, and in some cases, speeds, of trains. PTC systems can provide frequent updates on train position, and in most cases speed. Most PTC systems also require modifications of the railroad's operating system and rules. A railroad can opt to install precision dispatching concurrently with PTC at a lower cost than the marginal cost of a stand-alone precision dispatching system. That is not to say that a railroad cannot attempt to install a stand-alone precision dispatching system. At least three railroads now report efforts to upgrade their computer-aided dispatching systems to include planning elements.

2004, pp. 35 et seq.

Precision dispatching involves traffic planners. FRA has identified two types of traffic planners that might be of use in precision dispatching:

> Tactical traffic planners (TTPs) produce plans showing when trains should arrive at each point on a dispatcher's territory, where trains should meet and pass, and which trains should take sidings. As the plans are executed, a TTP takes the very detailed train movement information provided by the PTC system and compares it with desired train performance. If there are significant deviations from plan, the TTP will re-plan, adjusting meet and pass locations to recover undesired lateness. TTPs make use of sophisticated non-linear optimization techniques to devise an optimal dispatching plan. Once a TTP prepares a plan, the dispatcher need only accept it. Then the computer-assisted dispatching system of PTC produces all authorities needed to execute the plan and sends them over the digital data link communications network to trains and maintenance-of-way vehicles. Some prototype TTPs have been developed and tested.
>
> Strategic traffic planners (STPs) - TTPs cannot function without knowing the schedule for each train. STPs measure train movements against a set of externally defined schedules that include information on scheduled block swaps and connections, both internal and with other railroads. STPs integrate a flow of information about actual train performance from the TTP, the performance of connections, and detailed consist information for all trains from operating data systems. They make cost-minimizing decisions on whether, and how, train priorities and schedules might be adjusted on a real-time basis. STPs are the highest-level real-time control system in the PTC hierarchy. STPs will be able to display the performance of trains against schedule, the real-time location of every train by type (e.g., coal, intermodal, grain, intercity passenger), and the location of trains at future times based on current performance. The Federal Aviation Administration developed an STP (called "central flow control") to support the U.S. air traffic control system; the same philosophy could apply to railroad STPs.

The main benefit of precision dispatching is that a railroad can have a dispatch plan that is updated and optimized at frequent enough cycles to provide near optimal operations. At least one railroad has contended that precision dispatching has no benefit because rail operations are unpredictable, due to unanticipated events, such as broken rails and broken equipment. FRA disagrees, and believes that unpredictable events are better managed when a railroad can respond promptly with optimized alternatives.

Further, even in ordinary operations, precision dispatching has much to offer. According to Smith, Resor, and Patel, significant reductions in travel time are available when there is a greater availability of real-time or near real-time information for railroad dispatchers. In fact, their study showed that a travel time reduction of 2.3% could be available as a result of dispatchers receiving train position information every 3.5 minutes, as can be expected under PTC A, rather than every 17 minutes, as would be expected under a classic CTC system. For this reason, the benefits of precision dispatching are included in the discussion of PTC A benefits.

FRA notes that even without precision dispatching, more precise information on where trains are would allow dispatchers to "roll up" authorities behind a train more rapidly as it passes, freeing the track for use by the next train more rapidly, which might create additional capacity, or enhanced throughput. *Nonetheless, the AAR objected to any such increases in estimated throughput.*

With effective meet/pass planning achievable with accurate position information and possibly supplemented with sophisticated computer analysis, system velocity and reliability can increase. When system velocity increases, each car reaches its destination more rapidly, and is available sooner for its next move. Likewise, each locomotive is ready more rapidly to pull its next train. This means the railroad can use less equipment to accomplish any given level of traffic.

Railroads disagreed with this point, saying that they already have the cars they need to transact business, and that there is no reduction in procurement cost. Further, many cars sit idle because of seasonal or cyclical shifts in demand for cars. Nevertheless, railroads still need to replace existing stock, and to buy locomotives to service different types of business as shipper demand patterns change. Railroads could accommodate these shifts in demand with less equipment, yielding considerable savings.

Zeta-Tech estimated these benefits at $400 million to $1 billion per year, for both PTC A and PTC B, but in a letter to FRA agreed with a point raised by the AAR, that the savings in car utilization should only be applied to the portion of the time a car is in motion.

As noted above, in response to Zeta-Tech and AAR's comments on ownership cost savings, FRA had reduced Zeta-Tech's estimate of the potential savings to railroads from precision dispatch (i.e., better utilization of plant and equipment) by 75% of the original estimates

Capacity Benefits

PTC B adds a central safety system, traffic planning functions, and the capability to both "pace" trains and apply more advanced energy management technology to reduce fuel consumption by improving train handling and the capability to implement "dynamic headways" (moving block train separation). Dynamic headways can increase line capacity by permitting shorter and lighter trains to operate on closer headways, rather than constraining all trains to the separation required by the longest and heaviest trains. Dynamic headways, in conjunction with a tactical planner, can reduce average running times.

Zeta-Tech measured the benefits of capacity improvements in terms of avoided infrastructure costs for track and signals, including maintenance. This estimate was derived by estimating the number of miles of track at or above capacity, and estimating the costs of investments that would need to be made in order to maintain an adequate level of service. Zeta-Tech estimated the benefit of improved capacity at $800 million to $1.2 billion per year.

Railroad commenters, including the AAR, stated that PTC safety systems may have the effect of reducing line capacity. They noted that the conservative braking algorithms used in current PTC projects may result in trains operating at slower speeds approaching targets. Further, even if it is possible to achieve dynamic blocks, the full benefit of the technology would be realized only in *multi-track territory. A major signal supplier called attention to the technical risk associated with dynamic block architectures, noting that such projects have not been successful in conventional railroading internationally.*

Demonstration of dynamic block capability is a major objective of the North American Joint PTC project, and several transit applications are presently being deployed using this approach. FRA agrees that dynamic block capability will be one of the last attributes of communication-based train control that will be deployed (due to the technical challenge, communications requirements, etc.). FRA believes that attainable PTC systems, used in combination with precision dispatching, can increase line capacity by releasing restrictions on movements to the rear of trains and more efficiently staging train operations, regardless of whether dynamic blocks are employed for freight operations.

FRA is aware of the challenges currently being experienced in developing and implementing braking algorithms within the current PTC projects. These difficulties must be overcome for PTC to be a viable safety system and contribute to the efficiency of the industry. FRA believes that these issues will be resolved through use of realistic train consist and track database information and a more refined understanding of how specific train types perform. During the period PTC is being implemented, railroads will also be converting to use of electronically-controlled pneumatic (ECP) brakes, which will lead to more extensive use of train braking; and that in turn will provide feedback on the actual performance of each individual train (as well as exception information on the braking systems on individual cars).

However, in response to comments, including those from the AAR in writing and at the Peer Review Workshop, FRA has modified the Zeta-Tech estimate, reducing it by 60%, to account for such issues as the fact that adding PTC is not as effective as double tracking in increasing capacity, and that a railroad could increase capacity substantially by installing a series of long sidings, at cost much less than that of double tracking. FRA believes this is a conservative assumption, and the societal benefits estimated remain significant even after reducing the estimate of this benefit substantially.

Shipper Benefits

Zeta-Tech, in its analysis, said that PTC can enable railroads to deliver shipments more rapidly, and with greater certainty of the arrival time, *a statement with which the AAR strongly disagreed in its comments*.

The theory underlying these projected benefits is that a PTC communications system, coupled with precision dispatching, could reduce delays and help trains adhere to their schedules. Implicit in this analysis is the assumption that precision dispatching, informed by real-time information, can improve recovery from unexpected occurrences.

Reduced variability in arrival time is extremely important to shippers, as it enables them to lower logistics costs. Zeta Tech estimated this benefit using three methodologies:

1. Determine the savings shippers might realize in terms of the reduced inventory portion of logistics cost reduction if service reliability improves. This would be one

measure of the total benefit available from improved service when PTC is installed. The Zeta-Tech report showed that a reduction in the cost of carrying safety stock may be a useful surrogate for a lower-bound measure of the total benefit available from improved reliability.

2. Determine what additional amount shippers might be willing to pay for improved service reliability.

3. Determine the cross-elasticity of demand and price relative to PTC-enabled improvements in transit time and its variability as reported in a study on total logistics cost that had been prepared for the Federal Highway Administration. This method for measuring the size of the total benefit provides a useful check on the first two methods used.

Zeta-Tech developed estimates of shipper benefits which ranged from $400 million per year to $2.6 billion per year. It appeared that the higher estimates might be unrealistic, so in developing a summary of benefits, Zeta Tech picked as representative figures estimates of shipper benefits between $400 million and $900 million per year for PTC A and between $900 million and $1.4 billion per year for PTC B.

These benefits would only occur if the improvements in service, as estimated by Zeta-Tech, were realized. AAR took strong exception to those estimated improvements in service, stating that many of the delays and uncertainties relate to handling of cars in yards and terminal areas and that even if PTC could perform as promised shippers would not see the projected service quality improvements.

FRA notes that the estimates provided above are based on achieving a 3.5-10% improvement in trip times and 3.8-11% improvement in reliability. Even though the absolute benefit numbers are large, these are modest improvements from a percentage viewpoint. FRA agrees it is not possible to say with certainty whether they might be achieved without testing and demonstrating the technology. For instance, precision dispatching requires development of very sophisticated software that proved to be a much greater challenge than originally anticipated by the first vendor to offer the product. It is also true that uncertainties with respect to yard dwell times may be more influential in affecting service quality than over-the-road planning. Nevertheless, this is an era in which all successful businesses are utilizing real-time data and analysis to address customer expectations. It is difficult to imagine that railroads, which are both capital and labor intensive, could contrive to make no gains in service quality with ready availability of current data regarding their train operations.

Modal Diversion

This model depends on the estimates of improved rail velocity and reliability derived in the Zeta-Tech study, which have been challenged by several commenters (see discussion above).

To assess the potential for highway to rail diversion, FRA employed the Department's Intermodal Transportation and Inventory Cost (ITIC) Model. The ITIC model measures shipper logistics cost for both highway and rail. If rail can improve its service offerings, lowering shipper logistics cost vis-à-vis highway service offerings, then rail should have the opportunity to better compete and potentially capture the business from motor carriers. Business that rail can capture from highway results in shipper logistics cost savings.

FRA used input values for improved transit time and service reliability developed by Zeta-Tech. **Of course, if the Zeta-Tech estimates are not correct, then neither are the estimates derived by FRA**. Zeta-Tech estimated that transit time would improve between 3.5% and 10% and that reliability would improve by between 3.8% and 11%. Details of the impact of modal diversion can be found in the 2004 report, Appendix B, and Appendix D, Tables 7 and 8.

One caution to readers of the diversion study: the study assumes constant railroad rates, which is not meant to be a realistic assumption. The assumption is meant to provide conservative estimates of total diversion. An artifact of using constant rates is that it appears in the study that railroad revenues will grow substantially. In reality most of that revenue would be passed on to shippers in the form of lower rates, and actual diversion would be greater. It does, however provide an indication that the shipper benefits in the Zeta Tech study might be conservative.

Heavy trucks operating over highways create a risk of accidents, and moving them to railroads removes that accident risk from the highways, although it does increase somewhat the rail safety risk. According to the diversion model, PTC will divert between 1.937 billion VMT and 3.723 billion VMT from highway to rail in 2010. The diversion increases to between 3.005 billion VMT and 5.714 billion VMT in 2020. The safety benefits of diversion accrue primarily to highway users.

As described here, the safety benefit from PTC would in part be offset by what FRA estimates to be volume related rail accident costs of $22 million to $44 million per year.

FRA estimates diversion of between 30.7 billion ton-miles and 59.5 billion ton-miles in 2010, and between 46.4 billion ton miles and 89.4 billion ton-miles in 2020. As previously noted, the 2010 figures may be overstated because the PTC systems might not be in place until 2010. This implies reduced air pollution costs between $68 million and $132 million in 2010, and between $102 million and $198 million in 2020. This benefit would accrue to the general public.

In its May 2000 Addendum to the 1997 Highway Cost Allocation Study, the Federal Highway Administration said that the cost responsibility[2] of an 80,000 pound combination was 8.65 cents (10.08 cents in 2009 dollars) per mile, but that the actual contribution of such combinations only covered 80% of their cost share. That means that such trucks created a net societal cost of 1.73 cents per mile, in 2000 dollars, or 2.02 cents, in 2009 dollars.

Again, railroad commenters strongly disputed the estimated improvements in velocity and reliability, without which benefits to shippers and the public would not be realized.

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[2]Highway Cost Responsibility is an entire chapter in the *1997 Federal Highway Cost Allocation Study*, , Federal Highway Administration, Washington, DC, 1997, pp. V-1 *et seq*.. The basic concept is that each user should pay the highway costs it creates or "occasions."

As noted above, FRA remains convinced that an integrated communications, command and control system such as PTC and allied elements should be able to contribute to improvements in service quality. Modal diversion is highly sensitive to service quality. It may be true that problems with terminal congestion and lengthy dwell times might overwhelm the benefits of PTC; or it may be that the other initiatives that the railroads have been pursing (reconfiguration of yards, pre-blocking of trains, shared power arrangements, car scheduling, AEI, etc.) might actually work in synergy with PTC.

Summary

FRA has done its best to integrate the analysis from the 2004 report with the analysis of the final rule. FRA has removed benefit elements, such as locomotive diagnostics, which no longer apply, and added more significant fuel savings, and increased accident cost savings, as a consequence of DOT adopting higher VSLs. The 2004 report did not account for adverse impacts of PTC funding, while this analysis has attempted to estimate those impacts. It would take between twenty and twenty five years for business benefits to bring the rule to the break-even point, assuming what seem to be reasonable costs and effective productivity enhancing systems. Should the railroads incur higher costs for PTC, the system may never pay for itself. Should productivity enhancing systems prove unfeasible, or institutionally unacceptable, the costs of PTC will far exceed its benefits.