NORFOLK SOUTHERN

Norfolk Southern Corporation
1200 Peachtree Street, N.E. - Box 123
Atlanta, Georgia, 30309

July 9, 2010

Ms. Jo Strang
Associate Administrator for
Railroad Safety / Chief Safety Officer
Federal Railroad Administration
1200 New Jersey Avenue, S.E., Mail Stop 25
Washington, DC 20590

RE: Norfolk Southern Railway Positive Train Control Implementation Plan (Docket FRA – 2010- 0060)

Dear Ms. Strang:

Enclosed please find version 1.3 of Norfolk Southern Railway Company's ("Norfolk Southern") PTC Implementation Plan (PTCIP). Modifications were made to clarify items in the Plan in response to the Federal Railroad Administration's letter of June 14 providing Norfolk Southern Approval with Conditions for its PTCIP. This Plan is Norfolk Southern's strategic positive train control implementation plan submitted in fulfillment of 49 CFR Part 236, Subpart I, §236.1009 and §236.1011 and amended to gain satisfactory resolution of the six items provided in Enclosure 1 of the aforementioned letter. This PTCIP is Norfolk Southern's plan for complying with the installation of mandatory PTC systems as required by the Rail Safety Improvement Act of 2008 § 104, Pub. L. 110-432, 122 Stat. 4848-4970, Oct. 16, 2008.

We note certain requirements of the 49 CFR Part 236, Subpart I continue to be subjects of reconsideration or review, the merits of which are not addressed herein.

In preparing this PTCIP filing, Norfolk Southern has determined that certain sections of the submission (as identified below) must be redacted on the grounds that they contain confidential trade secrets, commercial and/or financial information within the meaning of 5 U.S.C. Section 552 and/or 18 U.S.C. Section 1905 (and thus Norfolk Southern hereby makes a request to the agency pursuant to 49 C.F.R. Section 209.11 that the redacted material be given confidential treatment on the foregoing grounds), and/or Safety Analysis Records subject to 49 U.S.C. Section 20118 and/or security sensitive information within the meaning of 49 C.F.R. Section 15.5. Disclosure is prohibited without the express written permission of Norfolk Southern. The sections of the PTCIP being redacted under the foregoing cited provisions and which have been appropriately marked are:

- Section 7.3: Risk Factors Included in Risk Prioritization Model
- Section 7.4: Risk Factors Weighting and Level
    - Including Subsections 7.4.1 through 7.4.8
- Section 7.6: Risk Prioritization Calculation
- Appendix B: Mainline Designation
- Appendix C: Installation Risk Analysis
- Appendix C-1: PTCIP Risk Factor Prioritization Model

- Appendix C-2: Anticipated Modifications to Traffic Characteristics
- Appendix C-3: Planned Modification to Operational Characteristics
- Appendix E: Wayside Deployment

As described in §236.1009(e)(3), this filing is being made in three separate parts: the redacted PTCIP, the complete PTCIP with redacted portions marked without obscuring the material but with SSI markings and other confidential restrictions, and the complete PTCIP (also marked SSI).

FRA has requested that PTCIP filings be made via the PTC Electronic Documentation Submission Portal. FRA has provided assurances via the Association of American Railroads (AAR) that the PTC Electronic Documentation Submission Portal is SSI compliant and supports these filings. Therefore Norfolk Southern is submitting the three requested PTCIP submission in electronic format via the PTC Electronic Documentation Submission Portal.

The Norfolk Southern contacts during review of this PTCIP submission are as follows:
Primary-

Lisa Wilson
Manager Advanced Train Control Regulatory Compliance and Training
1200 Peachtree St., N.E. - Box 123
Atlanta, GA 30309
Email: Lisa.Wilson@nscorp.com
Phone: 404-962-5931

Secondary-

Tom Schnautz
Director Advanced Train Control Systems
1200 Peachtree St., N.E. - Box 123
Atlanta, GA 30309
Email: Tom.Schnautz@nscorp.com
Phone: 404-527-2888

Please contact me if you have any questions or require additional information.

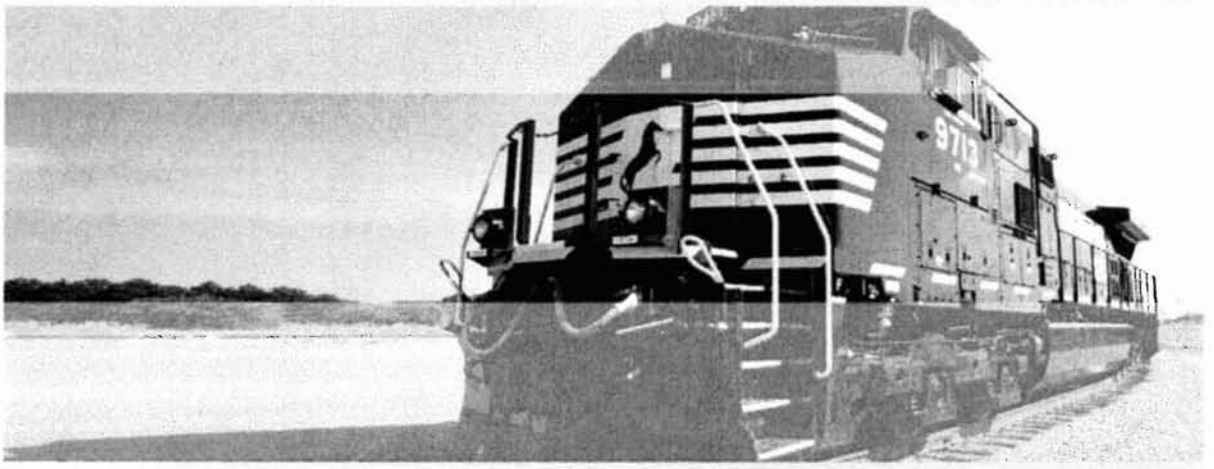
Kindest Regards,

Lisa Wilson

Lisa Wilson
Manager ATC Regulatory Compliance and Training

cc: Tom Schnautz

Norfolk Southern Railway PTC Implementation Plan (PTCIP)



9 July 2010

Submitted in fulfillment of 49 CFR Part 236, Subpart 1, § 236.1011

This page is intentionally left blank.

REVISION HISTORY

Date	Version	Description	Author
16 April 2010	1.0	Initial NS PTCIP Submittal to FRA	NS- LCWilson
27 May 2010	1.2	Clarification of items following FRA initial review	NS- LCWilson
9 July 2010	1.3	Clarification of items for approval	NS-LCWilson

Table of Contents

Page

1 Introduction 1

1.1 Overview 1
1.1.1 Organizational Relationships 2
1.1.2 Request for Amendment of a PTCIP [§236.1009(a)(2)(ii)] 4
1.2 Goals and Objectives 5
1.3 Success Criteria 8
1.3.1 Metrics for Long Term Goals 9
1.3.2 Metrics for Intermediate Goals 11
1.3.3 Metrics for Short Term Goals 12
1.4 Applicability 13
1.5 Document Overview 13
1.6 Acronyms and Definitions 14

2 Applicable Documents 17

3 Functional Requirements [§ 236.1011(a)(1)] 18

4 Compliance [§ 236.1011(a)(2)] 23

4.1 PTCDP, Type Approval, PTCSP, and System Certification 23
4.2 Potential Risks to Finish Date 23

5 Interoperability [§236.1011(a)(3)] 30

5.1 Railroad Agreement Provisions Relevant to Interoperability [§236.1011(a)(3)(i)] 30
5.2 Methods to Achieve Interoperability [§236.1011(a)(3)(ii)] 31
5.3 Interoperability Next Steps and Obstacles [§236.1011(a)(3)(iii)] 34

6 Designating Track as Main Line or Non-Main Line [§ 236.1011(a)(8)] 36

6.1 Mainline Designation 36

7 Installation Risk Analysis [§ 236.1011(a)(4)] 38

7.1 Overview 38
7.2 Methodology 38
7.3 Risk Factors Included in Risk Prioritization Model 42
7.4 Risk Factors Weighting and Risk Level 42
7.4.1 Annual Million Gross Ton (MGT) Levels 42
7.4.2 Presence and Volume of Passenger Traffic 44

7.4.3 Presence and Volume of TIH/PIH Material (Loads and Residue) Transported 45
7.4.4 Number of Tracks 46
7.4.5 Method of Operation 48
7.4.6 Speed of Train Operations 49
7.4.7 Track Grades 51
7.4.8 Track Curvature 52
7.5 Norfolk Southern Rail Network Description 54
7.6 Risk Prioritization Calculation 55

8 Deployment Sequence and Schedule [§ 236.1011(a)(5)] 56

8.1 Segment Traffic Characteristics [§ 236.1011(a)(5)(i)] 58
8.2 Segment Operational Characteristics [§ 236.1011(a)(5)(ii)] 58
8.3 Route Attributes [§ 236.1011(a)(5)(iii)] 59

9 Rolling Stock [§ 236.1011(a)(6)] 60

9.1 Locomotives to be Equipped [§ 236.1011(a)(6)(i)] 60
9.2 Schedule & Progressive Implementation [§ 236.1011(a)(6)(ii)] 61
9.3 Reporting [§ 236.1011(a)(6)(iii)] 63
9.4 Tenant Railroads [§ 236.1011(a)(6)(iv)(A) and (B)] 63

10 Wayside Devices [§ 236.1011(a)(7)] 64

11 Exceptions to Risk-Based Prioritization [§ 236.1011(a)(9)] 66

12 Strategy for Full PTC System Deployment [§ 236.1011(b)] 67

13 Main Line Track Exclusion Addendum [§ 236.1019] 69

14 Appendices 70

Appendix A: Interoperability Agreements 70
Appendix A-1: Tenant Railroad Responses Locomotive Equipping 70
Appendix B: Mainline Designation 70
Appendix C: Installation Risk Analysis 70
Appendix C-1: Positive Train Control Implementation Plan (PTCIP) Risk Factor Prioritization Model 70
Appendix C-2: Anticipated Modifications to Traffic Characteristics 70
Appendix C-3: Planned Modifications to Operational Characteristics 70
Appendix D: Locomotives to be Equipped 70
Appendix E: Wayside Deployment 70

1 Introduction

1.1 Overview

This PTC Implementation Plan (PTCIP or the Plan) is Norfolk Southern Railway Company's ("NS") strategic positive train control implementation plan submitted in fulfillment of 49 CFR 236, Subpart I, §236.1009 and §236.1011. A PTCIP is a railroad's plan for complying with the installation of mandatory PTC systems as required by the Rail Safety Improvement Act of 2008 § 104, Pub. L. 110-432, 122 Stat. 4848-4970, Oct. 16, 2008 (RSIA08). For Norfolk Southern Railway, that system is the Wabtec Railway Electronics (WRE) Vital Electronic Train Management System (V-ETMS®), a vital overlay system as defined in 49 CFR 236, Subpart I, §236.1015(d)(2).

In the 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 PTCIP indicating where and how it intends to install PTC systems by December 31, 2015. This filing represents Norfolk Southern Railway's plan as well as the joint filing of the PTCIP between NS and its intercity and commuter railroads that are tenants on its lines as per 49 CFR 236, Subpart I, §236.1009(a)(3).

It is Norfolk Southern Railway's plan to deploy PTC on those line segments that meet the requirements of RSIA08 and 49 CFR 236, Subpart I. Per 49 CFR 236, Subpart I, §236.1005(b)(2) a review of 2008 historical system data was conducted resulting in the development of this Plan which includes 10,904 miles of mainline track segments representing 159 line segments of NS's 562 total districts. Operating characteristics of those line segments varies by line. The rail network over which PTC will be deployed consists of five methods of operation and is predominantly comprised of Traffic Control/261 territory, followed by non-signaled/171 territory, Automatic Block System/271 and Current of Traffic/251, and a small portion of Cab Signaled territory. A detailed discussion of method of operation can be found in Section 7.4.5. The maximum authorized speed can vary on a line segment and across the line segments. The specifics regarding speed of track are discussed further in Section 7.4.6. NS had no Mainline Track Exclusion Addendum to report as is detailed in Section 13. Additionally, NS has limited passenger operations on approximately 14% of its network. Further details regarding passenger traffic are covered in Section 7.4.2. Other factors considered in the risk based assessment are covered in detail in Section 7 and are redacted for confidential treatment.

Implementation will be spanned beginning from approval of this Plan until the 12/31/2015 completion target. Per §236.1009(d)(4), a formal start date will be largely based upon FRA PTC System Certification, as the system may not be placed in service until such certification is obtained. Work toward the implementation effort can be progressed prior to certification, including installation, testing, revenue demonstrations; however the Rule is clear that revenue service may only begin following PTC System Certification. To the largest degree possible, NS will work on areas of PTC deployment which are expected to have the least change during the

PTC system design, development, testing, and certification process. The work effort will be divided into three tiers of deployment based upon a variety of risk and business continuity factors discussed in detail in Section 7, Installation Risk Analysis and Section 8, Deployment Sequence and Schedule. NS is progressively deploying PTC in areas of greater risk to the public and railroad employees before areas of lower risk, based on the deployment tiers described in the opening paragraphs of Section 8.

Norfolk Southern Railway's PTC project success ultimately depends upon an effective combination of resources committed to structure and control processes that provide a means to manage various project variables and their associated risks to meet the desired objectives.

Beyond the Federal requirement for the PTCIP imposed in RSIA08, there are four basic objectives for this implementation plan and the associated project planning:

- To eliminate or reduce uncertainty;
- To obtain a clear understanding of the scope and objectives;
- To improve efficiency of the project; and
- To provide a template for monitoring and controlling the work effort.

All metrics, dates and goals are predicated on the assumption that NS's PTC system will be certified by the FRA Associate Administrator no later than April 2012, two years from the date of this filing. This is perhaps the most crucial item on the critical path. Any shift beyond this date will likely cause subsequent revisions to the deployment and implementation goals described in this Plan. In addition, if negative effects are experienced during PTC deployment impacting safety of operations, network fluidity, or customer service, NS will delay further deployment until issues can be resolved. A discussion of additional associated risks is provided in Section 4 Compliance. The amount of information and operational data necessary to be collected and coalesced to build and support this Plan is without precedent. Norfolk Southern has made every attempt to work in good faith to insure accuracy and completeness but recognizes that exceptions may be found. As the PTCIP is a living document, NS will work with the FRA and provide the FRA with periodic updates on change while it reviews its Plan. As the need to make amendments is identified, NS will prepare RFAs as required per the process described in Section 1.1.2. Annual reports will be made to the FRA as required by §236.1006(b)(2) and as provided in Section 9.3.

1.1.1 Organizational Relationships

Since the formal start in 2005 for development of a positive train control system at Norfolk Southern, there has been commitment throughout the organization to the success of PTC on NS. From 2005 until the present, the majority of the PTC team at NS has been a part of a matrix organization. That is, they remained a member of and reported to their business functional department but were resourced to the PTC project on a full or part-time basis, depending upon their skills and contribution. This matrix approach allowed functional departments to focus on their specific competencies and has allowed the PTC project to be staffed with specialists from

throughout the NS organization while the PTC system is developed and tested. The main advantage of the matrix organization is the efficient allocation of all resources, especially scarce specialty skills. This organizational approach has also strengthened communication, coordination, and cooperation between multiple functional, line, and project managers and their associated resources.

The PTC project will be managed with the following roles and responsibilities as illustrated in *Figure 1. NS PTC Organization Chart* which follows:

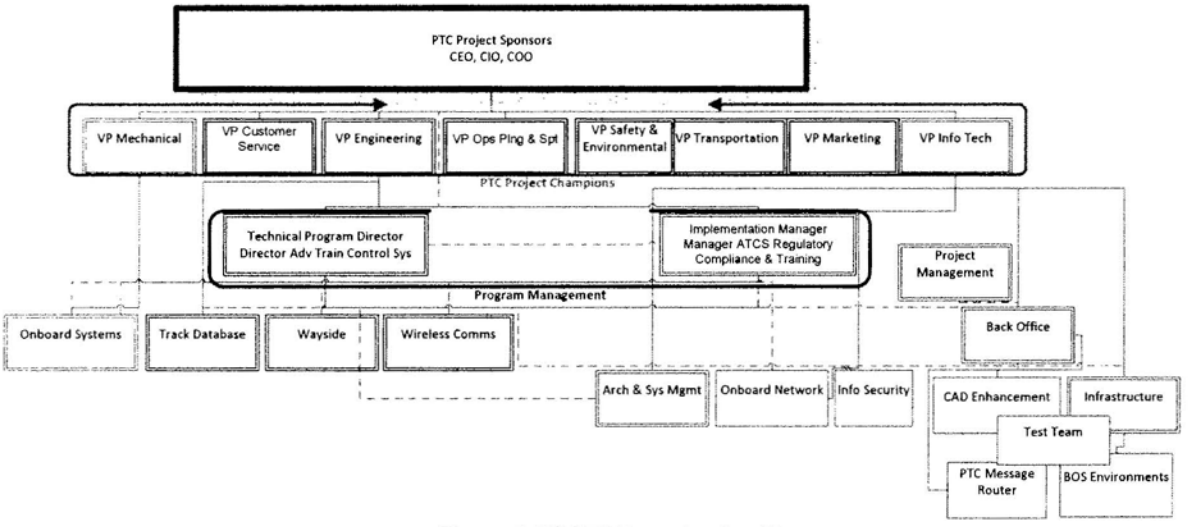


Figure 1. NS PTC Organization Chart

Project Sponsors are Norfolk Southern's Chief Executive Officer, Chief Information Officer, and Chief Operating Officer who assist with and provide strategic guidance on goal setting, conflict resolution, key staffing, project master planning, and project execution monitoring. Support at the highest level of the organization sends a clear message as to the import and critical nature of the success of this project.

Project Champions are NS vice presidents from all key business and operations areas affected by PTC: Customer Service, Engineering, Information Technology, Marketing, Mechanical, Operations Planning, Safety & Environmental, and Transportation. PTC Champions provide similar functions as Sponsors but at a tactical level regarding decisions, risks, resources, costs or schedule affecting their line of business. Their main role is to remove roadblocks for the program managers.

PTC at NS has a technical program director, Director Advanced Train Control Systems, who has responsibility for the overall success of the PTC project. This position is the technical authority for PTC at NS. NS also utilizes an implementation manager, the Manager ATCS

Regulatory Compliance & Training, who is the primary interface to all tenant railroads and the FRA for regulatory compliance and documentation. These two functions drive the project execution to plan for cost, schedule and quality. Additionally, these roles manage the inputs to the train control project of capital, material, equipment, requirements/data and personnel. There are several project managers resourced to working teams or departments. A primary project manager residing in Information Technology coordinates project status between these PMs and project managers from Norfolk Southern's PTC vendors.

Each month, meetings are conducted by the program director and implementation manager with the Project Sponsors and the Project Champions to keep them versed in the developments of the project. These information sessions serve as an opportunity for NS leadership to inquire about aspects of the project or to learn how they may assist in removing impediments to progress. With this coordinated and mutually beneficial view of the project, PTC at NS avoids suffering from a departmental silo management approach.

Working Team/Functional Resources are part of the matrix organization previously referred to and include resources in Customer Service, Engineering, Information Technology, Marketing, Mechanical, Operations Planning, Operating Rules, and Transportation as well as those in Financial Planning, Human Resources, Labor Relations, and Law. Each individual assigned to or working with the PTC project brings a unique skill set or background to the project. All have a shared commitment to the goals of the project, understand the critical nature of PTC successful implementation, and realize the importance of the coordination of work activities and shared communication. Each resource selected to join the PTC effort brings the requisite technical, managerial, leadership, and communication skills needed to proficiently perform the required tasks.

The PTC organization will have reporting accountability to the Chief Operating Officer with line responsibility through the Engineering, Mechanical, Customer Service and Transportation departments. Information Technology will provide support for the back office segment. Responsibility for the success of the PTC project lies with the Director Advanced Train Control Systems.

1.1.2 Request for Amendment of a PTCIP [§236.1009(a)(2)(ii)]

As FRA recognizes, after submittal of the Plan, NS may have legitimate reasons for making changes in the deployment schedule or the locations where the system is installed or other updates to the plan as changes occur. Accordingly, NS may find the need to modify its PTCIP through the Request for Amendment (RFA) process provided in §236.1021. Modifications to the finalized and FRA-approved Plan will need to be requested through the Manager ATCS Regulatory Compliance & Training who has responsibility for the configuration of the PTCIP.

RFAs will be approved through the Vice President of Operations, Planning and Support or his/her designee.

Referencing §236.1021(a), after this Plan is approved by FRA and before any change is made to the PTC system's implementation, NS will file an RFA to its PTCIP. Norfolk Southern will annually review operations for any material changes as described in § 236.1005(b) that would affect the PTCIP. If it is determined that any of the changes identified "Initiate a new category of service; or Add, subtract, or otherwise materially modify one or more lines of railroad for which installation of a PTC system is required," NS will prepare an RFA to this PTCIP as per § 236.1021.

NS PTC Project Champions, as described in Section 1.1.1, will review the draft RFA proposal and its documentation prepared by the Manager ATCS Regulatory Compliance & Training. Following review and comment, the draft RFA will be finalized and prepared for authorization and internal approval by the Vice President of Operations, Planning and Support. Prior to formal filing of an RFA, Norfolk Southern Railway will make reasonable attempts to informally confer with the FRA regarding any proposed changes to the Plan to discuss the details of the change(s). This will help to assure FRA's understanding of what NS wishes to change and the change's potential impact. The Manager Regulatory Compliance and Training will prepare the final RFA and PTCIP and formally file both with the FRA as per §236.1009(e)(3).

NS understands that until the FRA Associate Administrator has granted appropriate relief or approval, it may not make the change, and once a requested change has been made, the railroad must immediately adopt and comply with the requested change.

1.2 Goals and Objectives

Consistent with Norfolk Southern's uncompromising focus on safety, NS is committed to meet the scope of the Congressional PTC mandate by developing and deploying positive train control on its rail network to ensure the safety of train operations, railroad employees, and the communities it serves. Consequently, the principal goal for the deployment of PTC technologies on the NS rail network is to enhance system safety, with particular focus on the prevention of train-to-train collisions, overspeed derailments, incursions into established work zone limits, and movement of trains through improperly-positioned switches. It should be noted; however, that in examination of the reportable accident statistics available from the FRA's public web site for all railroads for 1999-2008, 35% of accidents were track related and 12% of reportable accidents were equipment related. Thus, 47% of reportable accidents were due to causes not expected to be affected by PTC deployment. Some 53% of reportable accidents were human factors-related or fell into miscellaneous categories. Less than 2% were determined to have been "PTC preventable."

Enhancements to system safety will be achieved as a PTC vital overlay system is progressively deployed across all portions of the network for which PTC deployment is required by 49 CFR

§236.1005(b), with all required in scope portions of the NS network to be fully equipped, operational, and interoperable with tenant railroads by December 31, 2015. Goals and objectives relating to various aspects of PTC deployment are described below.

***Safety and Performance*:** Deployment of PTC technologies will be conducted in full compliance with all applicable Federal requirements, including those specified in 49 CFR Part 236 Subpart I, and an acceptable level of safety will be maintained in the development, functionality, architecture, installation, implementation, inspection, testing, operation, maintenance, repair, and modification of the PTC technologies to be deployed. The Norfolk Southern Railway PTCSP shall provide the railroad-specific information demonstrating that the V-ETMS system, as implemented, meets the required safety performance objectives. To ensure that an acceptable level of safety is achieved, the methodologies and activities to be defined in the PTCSP, as required by 49 CFR §236.1015, will be followed; and as a part of this, NS will ensure that all vendors from whom PTC technologies are acquired will have an acceptable quality assurance program for both design and manufacturing processes. The detailed results and conclusions regarding the categorization, elimination, and/or mitigation to an acceptable level, of any identified hazards shall be documented and provided in the PTCSP. This information is expected to satisfy the criteria called out in 49 CFR Part 236, Subpart I Appendix C.

NS will work to ensure safe and reliable functionality and interaction between the wayside, on-board, and office components of the PTC system, with the communications component of the system providing the hardware and software elements that interface with and provide the required connectivity between the other PTC system components. This holistic view is necessary, as products from multiple vendors are integrated into the PTC system design.

SP Goal 1: Submit PTCSP for Vital Electronic Train Management System (V-ETMS), a vital overlay system

SP Goal 2: Demonstrate the V-ETMS system, as implemented, meets the required safety performance objectives

SP Goal 3: Insure all vendors from whom PTC technologies are acquired have acceptable quality assurance programs for design and manufacturing processes

SP Goal 4: Maintain an acceptable level of safety in the development, functionality, architecture, installation, implementation, inspection, testing, operation, maintenance, repair, and modification of the PTC technologies deployed

Progressive Risk-Based Deployment: The progressive deployment of PTC technologies across NS's line segments will occur, to the extent practical, such that the PTC system will be implemented to address areas of greater risk to the public and railroad employees before areas of lesser risk. NS will achieve progressive implementation of onboard systems and deployment of PTC-equipped locomotives so that the safety benefits of PTC are achieved through incremental growth in the percentage of equipped controlling locomotives operating on PTC equipped lines.

PRBD Goal 1: Address areas of greater risk to the public and railroad employees before areas of lesser risk consistent with resource availability, labor agreements, and other constraints
PRBD Goal 2: Achieve safety benefits of PTC through progressive equipping of controlling locomotives operating on PTC lines
PRBD Goal 3: Achieve on time delivery of milestones for deployment

Regulatory Compliance: In order to meet the December 31, 2015 deadline mandated by Congress, NS has developed this PTCIP in accordance with §236.1011. On 24 March 2010, NS submitted a PTCDP describing the V-ETMS system NS intends to deploy, in accordance with §236.1013. Both the PTCDP and this PTCIP have been submitted to FRA for approval by the required April 16, 2010 deadline. Implementation of this safety-critical processor-based signal and train control system shall be in compliance with all requirements within Subpart I, the approved PTCSP, and §236.1009 prior to beginning operations. Confirmation of compliance shall be established through review of documentary evidence, safety V&V testing, or other reviews or analyses necessary to establish compliance with safety requirements. Evidence of compliance shall be documented. Railroad operations after implementation of the product shall remain in compliance with the operational design limits as specified in the PTCSP. It is NS's intent to achieve FRA PTC System Certification by second quarter, 2012 and to deploy PTC on all required portions of the network by 1 December 2015, so NS's PTC system will be fully operational by December 31, 2015 as required by RSIA08.

RC Goal 1: Develop the PTCDP and PTCIP to meet requirements of §236.1009, §236.1013 and §236.1011
RC Goal 2: Submit the PTCDP and PTCIP no later than 16 April 2010
RC Goal 3: Submit Field Testing filing per §236.1035 based upon PTCDP Type Approval and prior to the start of field testing
RC Goal 4: Submit the PTCSP upon satisfactory completion of PTC system testing
RC Goal 5: Obtain PTC System Certification no later than second quarter 2012

Interoperability: The PTC system, as described in the V-ETMS PTCDP already filed with FRA, is designed to facilitate technical and semantic interoperability between Norfolk Southern Railway and its tenant railroads. Organizational interoperability will help ensure that the right players are involved in decision making, planning efforts, communication and collaboration, and other activities to enhance the ability of NS and its tenants to operate together safely. Interoperability between NS and its tenants will be achieved through extensive product testing in lab and production scenarios. Further, the ongoing industry and community partnership through the Interoperable Train Control consortium, participation in AAR committees and standards, informal and formal PTC user committees, and standard V-ETMS implementations will all support interoperability. NS and its tenants will work together throughout the PTC deployment process to ensure that all aspects of interoperability are fully addressed. This partnership will be on-going as the railroads continue to operate on PTC equipped portions of the NS network into the future.

Interop Goal 1: As a participant in ITC, contribute to ITC technical team deliverables for development of publishable interoperable standards to which other roads can develop
Interop Goal 2: Achieve organizational interoperability through close communications and coordination with other hosts and tenants
Interop Goal 3: Demonstrate technical and semantic interoperability through successful testing
Interop Goal 4: Demonstrate that a controlling locomotive of another railroad can communicate with and respond to the NS's positive train control system, including uninterrupted movements over property boundaries

System Coverage: In compliance with the requirements of §236.1005, NS will be equipping 159 of its 562 districts with PTC technology, corresponding with approximately 66% of NS's 16,500 route miles. This is aligned with the Congressional goal of reducing the number and rates of accidents, incidents, injuries, and fatalities involving railroads, as identified in Section 102 of RSIA08.

SysCov Goal 1: Implement PTC on all in scope line segments as required by RSIA08 and 49 CFR Part 236 Subpart I
SysCov Goal 2: Insure PTC is deployed to meet Congressional requirement to reduce risk to the public and rail employees

Operating Efficiency & System Reliability: Norfolk Southern is in business to serve its customers. To do so, the railroad must maintain a disciplined operation focused on safety first, performance and adherence to plan to meet its objectives. Many factors contribute to operating efficiency and system reliability, some of which include locomotive reliability, train connections made as scheduled, train performance (trains arriving on-time at the destination terminal), and technology availability. As PTC is deployed, the system will have an effect on the entire operation of NS and its ability to provide service to its customers. This requirement is, in effect, taking existing systems (e.g. locomotive, office, wayside, etc) and adding a layer for PTC. The inherent reliability of the underlying systems is subject to compromise unless we have 100% availability/reliability from all the new PTC components, thereby adding risk to meeting customer service, operating efficiency and performance objectives.

OpEffSysRel Goal 1: Prevent degradation of on time train performance due to PTC system related delays
OpEffSysRel Goal 2: Support customer service expectations in connection performance by minimizing PTC deployment impacts
OpEffSysRel Goal 3: Maintain high level of customer satisfaction through shipment consistency against schedule

1.3 Success Criteria

This section of the PTCIP describes the metrics that will be applied to gauge the successful completion of implementation milestones. For clarification, when referred to in this section, long term metrics generally refer to Norfolk Southern Railway's implementation milestones

from a system point of view and over the entire implementation window. Intermediate goals refer to NS's implementation milestones from either a line segment or transitional point of view. Short term goals and metrics cover a window of time in the year following submittal of the PTCIP.

1.3.1 Metrics for Long Term Goals

To assess performance against long term goals, NS plans to measure System Coverage and Progressive Risk Based Deployment, through Locomotive Installation and Wayside Equipping.

1.3.1.1 System Coverage

After NS receives PTC System Certification from the Associate Administrator as set forth in §236.1015 (a), line segments with PTC installed will be placed in service. To be considered ready to be placed in service, a number of milestones for that line will have been met, including but not limited to:

1. All wayside installs complete
2. Locomotives equipped and available for PTC train service on the line
3. All training for all applicable workers and crafts complete
4. Track validation and verification complete
5. Communications infrastructure installed, tested and validated
6. All in service testing complete

System coverage is the culmination of all factors that lead to the progressive equipping of trains for PTC service. As lines are readied for service, a commissioning process will occur for final validation of a line segment. Along with the factors described above, commissioning completes a line's PTC readiness. The total number of PTC equipped trains will depend on the number of NS train starts and revenue trains. While NS cannot accurately predict those values into the future, it has set goals for lead locomotive equipping, detailed below and in Section 9.2, Rolling Stock; and for equipping the Wayside, the second critical vital system component detailed below and in Section 10.

Because of the many factors affecting implementation, success regarding system coverage will be tracked to a percentage range goal of route miles completed by each year's end to allow for geographical and environmental variances in line segments. In the event negative effects are experienced during PTC deployment impacting safety of operations, network fluidity, or customer service, NS will delay further deployment until issues can be resolved. It is NS's intent to recover any unforeseen delays whenever and wherever possible with a host of mitigation strategies, some of which are discussed in Section 4 of this Plan.

NS Sytem Coverage Goals

Year	*Total Route Miles Implemented By End of Year*
2011	Dependent upon PTC System Certification
2012	20 - 35%
2013	50 - 65%
2014	75 - 85%
2015	100%

1.3.1.2 Progressive Risk Based Deployment

1.3.1.2.1 Locomotive Installations

Because NS does not assign its locomotives per district, it is appropriate to consider the equipping of rolling stock as a long term, progressive goal. The actual number of units will change as business and operational climate changes occur, but it is NS's intent to equip the majority of the NS fleet, excluding locomotives dedicated exclusively to yard service. As discussed in Section 9 of this Plan, NS will utilize the following annual metrics, the responsibility of the VP Mechanical, for the number of locomotives that it shall have equipped with PTC:

Year	*Locomotive Units Equipped*	*Total PTC Equipped Units*
2011	1,177	34.5%
2012	1,877	55.0%
2013	2,577	75.5%
2014	3,277	96.1%
2015	3,411	100%

1.3.1.2.2 Wayside Equipping

As detailed in Section 10 of this Plan, wayside equipping is a major component of the successful implementation of PTC. As there are many factors that impact successful wayside deployment, delays may be incurred due to product availability or maturity of the technical solution based on the concurrent PTC development and testing effort. While each line segment will be assessed through project management efforts, the overall progress of wayside deployment will be measured by the VP Engineering on the following scale:

to commission a PTC track segment will be fully described in the PTCSP. These procedures will be performed consistent with the approved system based upon successful FRA PTC System Certification. Field testing will confirm proper PTC system operation.

1.3.2.3 Training Completed

PTC system related training will be conducted in accordance with §§236.1041 through 236.1049. The specific training procedures required will be fully described in the PTCSP. These procedures will be performed consistent with the approved system based upon successful FRA PTC System Certification. As an intermediate objective, training goals will be met upon completion of the following:

- All affected field and office maintenance personnel, as described in §236.1041(a)(1), for the district have completed training in accordance with procedures established in the PTCSP.
- All affected dispatchers, as described in §236.1041(a)(2), for the district have completed training in accordance with procedures established in the PTCSP.
- All affected persons who operate trains or serve as a train or engine crew, as described in §236.1041(a)(3), for the line segment have completed training in accordance with procedures established in the PTCSP.
- All affected roadway workers, as described in §236.1041(a)(4), for the district have completed training in accordance with procedures established in the PTCSP.
- All affected direct supervisors, as described in §236.1041(a)(5), for the line segment have completed training in accordance with procedures established in the PTCSP.

1.3.3 Metrics for Short Term Goals

The following metrics are related to the success of meeting the PTC System goals for Safety & Performance and Regulatory Compliance:

1.3.3.1 PTCSP Submitted

As put forth in §§236.1009 and 236.1015, NS is required to submit a PTCSP in order to obtain PTC System Certification from the FRA Associate Administrator. This short term goal shall be considered complete once the PTCSP has been submitted to the FRA.

to commission a PTC track segment will be fully described in the PTCSP. These procedures will be performed consistent with the approved system based upon successful FRA PTC System Certification. Field testing will confirm proper PTC system operation.

1.3.2.3 Training Completed

PTC system related training will be conducted in accordance with §§236.1041 through 236.1049. The specific training procedures required will be fully described in the PTCSP. These procedures will be performed consistent with the approved system based upon successful FRA PTC System Certification. As an intermediate objective, training goals will be met upon completion of the following:

- All affected field and office maintenance personnel, as described in §236.1041(a)(1), for the district have completed training in accordance with procedures established in the PTCSP.
- All affected dispatchers, as described in §236.1041(a)(2), for the district have completed training in accordance with procedures established in the PTCSP.
- All affected persons who operate trains or serve as a train or engine crew, as described in §236.1041(a)(3), for the line segment have completed training in accordance with procedures established in the PTCSP.
- All affected roadway workers, as described in §236.1041(a)(4), for the district have completed training in accordance with procedures established in the PTCSP.
- All affected direct supervisors, as described in §236.1041(a)(5), for the line segment have completed training in accordance with procedures established in the PTCSP.

1.3.3 Metrics for Short Term Goals

The following metrics are related to the success of meeting the PTC System goals for Safety & Performance and Regulatory Compliance:

1.3.3.1 PTCSP Submitted

As put forth in §§236.1009 and 236.1015, NS is required to submit a PTCSP in order to obtain PTC System Certification from the FRA Associate Administrator. This short term goal shall be considered complete once the PTCSP has been submitted to the FRA.

1.3.3.2 PTC System Certification Received

§236.1015(a) states that the "receipt of a PTC System Certification affirms that the PTC system has been reviewed and approved by the FRA in accordance with, and meets the requirements of, this part." Upon receipt of PTC System Certification from the FRA Associate Administrator, the system configuration shall be considered operational.

1.4 Applicability

In compliance with the requirements of §236.1005, NS plans to equip 159 of its 562 districts with PTC technologies, corresponding with approximately 66% of NS's 16,500 route miles. Details for the segment traffic, operational and route attributes are found in Section 8 and its associated appendix.

Consistent with its focus on safety of operations, Norfolk Southern Railway will continue to evaluate its operations and track segments to determine PTC system applicability. At this time, NS has not identified any additional line segments not already included in this Plan to be deployed with PTC. Additional details related to NS's plan for further PTC deployment are contained in Section 12.

1.5 Document Overview

This Plan is organized to specifically address the requirements 49 CFR 236, Subpart I, §§236.1009, 236.1011, and other sections referenced by the PTCIP filing requirements. An overview of the document layout and the specific regulatory references is provided to facilitate review:

- Section 1 describes the general objectives, applicability, and scope of the document.
- Section 2 lists applicable documents that are referenced in this PTCIP.
- Section 3 describes the functional requirements that the proposed system must meet as required by § 236.1011(a)(1).
- Section 4 describes how the railroad intends to comply with § 236.1009(c) and (d) as required by § 236.1011(a)(2).
- Section 5 defines how the railroad will provide for interoperability between the host and all tenant railroads as required by § 236.1011(a)(3).
- Section 6 identifies which track segments the railroad designates as main line and non-main line track, as required by § 236.1011(a)(8).

- Section 7 describes how the PTC system will be implemented to address areas of greater risk to the public and railroad employees before areas of lesser risk, by evaluating multiple risk factors, as required by § 236.1011(a)(4).

- Section 8 defines the sequence, schedule, and decision basis for the line segments to be equipped, including the risk factors by line segment, as required by §236.1011(a)(5).

- Section 9 identifies the rolling stock that will be equipped with the PTC technology, as required by § 236.1011(a)(6) and defines a schedule for same.

- Section 10 identifies the number of wayside devices required for each line segment and the schedule to complete the installations by December 31, 2015, as required by § 236.1011(a)(7).

- Section 11 identifies and describe the railroad's basis for determining that the risk-based prioritization in Section 7 above is not practical as required by § 236.1011(a)(9).

- Section 12 contains the strategy for full system-wide deployment of PTC systems beyond those line segments required to be equipped under 49 CFR Part 236, Subpart I, § 236.1011(b) including the criteria that will be applied in identifying those additional lines.

- Section 13 contains the Main Line Track Exclusion Addendum (MTEA) as defined by § 236.1019.

- Section 14 lists any Appendices, either directly or by reference, that provide supporting details that could aid in the understanding of the PTCIP.

1.6 Acronyms and Definitions

This section shall include definitions of all terms, abbreviations, and acronyms required to properly interpret the Implementation Plan.

The following is a list of some abbreviations and acronyms that may be used in the PTCIP:

Acronym	Meaning
CFR	Code of Federal Regulation
FRA	Federal Railroad Administration
GIS	Geographical Information System
ITC	Interoperable Train Control
MTEA	Main Line Track Exclusion Addendum
NPI	Notice of Product Intent
PIH	Poison by Inhalation Hazard
PTC	Positive Train Control
PTCDP	Positive Train Control Development Plan

PTCIP	Positive Train Control Implementation Plan
PTCSP	Positive Train Control Safety Plan
RFA	Request For Amendment
TIH	Toxic Inhalation Hazard
U.S.C.	United States Code
V&V	Verification & Validation

The following is a list of definitions of terms that may be used in the PTCIP:

Class I railroad	A railroad which in the last year for which revenues were reported exceeded the threshold established under regulations of the Surface Transportation Board (49 CFR part 1201.1-1 (2008)).
District	A portion of an operating division designated by timetable. Districts are supervised by trainmasters.
Host railroad	A railroad that has effective operating control over a segment of track.
Interoperability	The ability of a controlling locomotive to communicate with and respond to the PTC railroad's positive train control system, including uninterrupted movements over property boundaries.
ITC	The Interoperable Train Control Agreement, executed in October 2008 by BNSF, CSXT, NSR and UPRR to develop a set of standards which would allow the participants to adopt an interoperable train control system, and or its working or technical committees
Line Segment	Same as a district.
Main line	Except as provided in §236.1019 or where all trains are limited to restricted speed within a yard or terminal area or on auxiliary or industry tracks, a segment or route of railroad tracks: (1) of a Class I railroad, as documented in current timetables filed by the Class I railroad with the FRA under §217.7, over which 5,000,000 or more gross tons of railroad traffic is transported annually, as reported on the traffic density map required to be filed with the Surface Transportation Board or (2) used for regularly scheduled intercity or commuter passenger service, as defined in 49 U.S.C. § 24102, or both.
Main line track exclusion addendum	The document further described in §236.1019.
NPI	Notice of Product Intent as further described in §236.1013.
PTC	Positive Train Control as further described in §236.1005.
PTCDP	PTC Development Plan as further described in §236.1013.
PTCIP	PTC Implementation Plan as required under 49 U.S.C. §20157 and

	further described in §236.1011.
PTC railroad	Each Class I railroad and each entity providing regularly scheduled intercity or commuter rail passenger transportation required to implement and operate a PTC system.
PTCSP	PTC Safety Plan as further described in §236.1015
PTC System Certification	Certification as required under 49 U.S.C. §20157 and further described in §§236.1009 and 236.1015.
Request For Amendment	A request for an amendment of a plan or system made by a PTC railroad in accordance with §236.1021.
Segment of track	Any part of the railroad where a train operates.
Tenant railroad	A railroad, other than a host railroad, operating on track upon which a PTC system is required.
Track segment	Segment of track

2 Applicable Documents

This section provides a complete list of all the documents and other sources referenced in the PTC Implementation Plan.

A. 49 CFR 236 Subpart I, "Positive Train Control Systems; Final Rule," Docket No. FRA-2008-0132, 15 January 2010
B. Vital Electronic Train Management System (V-ETMS®) Positive Train Control Development Plan, 24 March 2010.
C. FRA- "Risk Prioritization Methodology for PTC System Implementation," 7 January 2010
D. FRA- "PTC Implementation Plan (PTCIP) TEMPLATE," 7 January 2010

Note: For dated references, only the edition cited applies. For undated references, the latest edition of the reference document applies, including amendments.

3 Functional Requirements [§ 236.1011(a)(1)]

As required by 49 CFR §236.1011(a)(1) the PTCIP will describe the functional requirements that the proposed PTC system must meet. A complete description of the V-ETMS® functionality is provided in the "Vital Electronic Train Management System (V-ETMS) Positive Train Control Development Plan." The PTCDP describes how V-ETMS satisfies the mandated requirements for PTC systems as outlined in §236.1005. On 24 March 2010, the PTC Development Plan ("PTCDP") prepared by Wabtec Railway Electronics ("WRE"), CSX Transportation ("CSXT"), Norfolk Southern Railway, and Union Pacific Railroad ("UPRR") was submitted to the FRA for review and approval. The PTCDP was jointly submitted for FRA Type Approval as set forth under 49 CFR Part 236, Subpart I §236.1009(b) and included documentation as required by §236.1013.

The V-ETMS Development Plan describes development of the WRE Vital Electronic Train Management System, an interoperable PTC system developed in compliance with requirements and standards defined through the Interoperable Train Control ("ITC") industry effort. V-ETMS is a locomotive-centric, vital train control system designed to be overlaid on existing methods of operation and provide a high level of railroad safety through enforcement of a train's authorized operating limits, including protection against train-to train collisions, derailments due to overspeed, unauthorized incursion into work zones, and operation through main track switches in improper position. The V-ETMS system is designed to support different railroads and their individual methods of operations and is intended to be implementable across a broad spectrum of railroads without modification. This design approach supports interoperability across railroads as V-ETMS equipped locomotives apply consistent warning and enforcement rules regardless of track ownership.

An overview of the V-ETMS system, its primary functions, the architecture of the PTC system(s) being deployed, and a high level description of the functionality of the PTC system, subsystems, and interfaces are all found in the PTCDP. Specifically, these areas are addressed in the following sections:

Section 3, V-ETMS Description, which provides a complete description of the V-ETMS system including a list of all product components and their physical relationships in the subsystem or system, as required by 49 CFR 236 Subpart I §236.1013(a)(1). Please reference the following subsections within Section 3:

- 3.1 Locomotive Segment
- 3.2 Office Segment
- 3.3 Wayside Segment
- 3.4 Communications Segment
- 3.5 Data Flow
- 3.6 V-ETMS Primary Functions

Section 4, PTC Architecture, which describes how V-ETMS architecture satisfies safety requirements as required by 49 CFR 236 Subpart I §236.1013(a)(4). Please reference the following subsections within Section 4:

4 PTC Architecture
4.1 Locomotive Segment
4.1.1 V-ETMS Train Management Computer
4.1.2 Computer Display Unit
4.1.3 GPS Receiver
4.1.4 Locomotive Event Recorder
4.1.5 Train Control Application
4.1.6 Business Applications
4.2 Office Segment
4.2.1 V-ETMS Office Segment
4.2.2 Office Server Platform
4.2.3 Office Segment External Interfaces
4.3 Wayside Segment
4.3.1 WIU Technology
4.4 Communications Segment
4.4.1 The Messaging System
4.4.2 Wireless Networks

The Concept of Operations, contained in Appendix A of the PTCDP, was provided as required by §236.1013(a)(3). This portion of the PTCDP addresses each of the PTC functional requirements as called out in the Subpart. While the entire Concept of Operations provides a thorough understanding of the system's ability to meet the requirements, for the purpose of this document, each requirement will be addressed as written in the Subpart and with a reference within the V-ETMS Development Plan, Appendix A, Concept of Operations as follows:

§ 236.1005 Requirements for Positive Train Control systems.

(a) *PTC system requirements.*

Each PTC system required to be installed under this subpart shall:

(1) Reliably and functionally prevent:

(i) Train-to-train collisions—including collisions between trains operating over rail-to-rail at-grade crossings ...

- Section 5.4 Train Movement
- Section 5.4.1 Movement Authority Provided by Mandatory Directive
- Section 5.4.2 Wayside Signals
- Section 5.4.3 Cab Signals
- Section 5.4.4 Reverse Movement
- Section 5.4.5 Switching Mode
- Section 5.4.6 Entry to V-ETMS Territory

- Section 5.4.7 Exit from V-ETMS Territory
- Section 5.4.8 Yard Limits
- Section 5.11 Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement
- Section 5.11.3 Restrictive Speed Enforcement

Related to train to train collisions as a requirement of the Subpart, is the provision for railroads to address rail-to-rail crossings-at-grade. In all cases where PTC equipped lines are involved, an interlocking signal arrangement developed in accordance with subparts A through G of part 236 will be in place. V-ETMS is designed to prevent train to train collisions where interlocking signals are in place as described in the V-ETMS PTCDP Sections 5.4.2 Wayside Signals and 5.4.3 Cab Signals. The method to be used by NS for protecting non-PTC routes at rail-to-rail crossing-at-grade will be dependent on the speed and the specific field conditions of each location, availability of alternate technologies to provide positive stop enforcement, and the presence of PTC equipped locomotives operating on the non-PTC routes.

(ii) Overspeed derailments, including derailments related to railroad civil engineering speed restrictions, slow orders, and excessive speeds over switches and through turnouts;

- Section 5.4.8 Yard Limits
- Section 5.5 Speed Limits and Restrictions
- Section 5.5.1 Permanent Speed Restrictions
- Section 5.5.2 Temporary Speed Restrictions
- Section 5.5.3 Track Authority Speed Restrictions
- Section 5.5.4 Consist or Lading Speed Restriction
- Section 5.11 Warning and Enforcement
- Section 5.11.1 Reactive (Overspeed) Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement
- Section 5.11.3 Restricted Speed Enforcement

(iii) Incursions into established work zone limits without first receiving appropriate authority and verification from the dispatcher or roadway worker in charge, as applicable and in accordance with 49 CFR part 214

- Section 5.6 Work Zones
- Section 5.11 Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement

(iv) The movement of a train through a main line switch in the improper position as further described in §235.1005(e).

- Section 5.10 Route Integrity Protection
- Section 5.10.1 Monitored Hand-Operated Switches
- Section 5.10.2 Switches in Signaled Territory
- Section 5.11 Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement

(2) Include safety-critical integration of all authorities and indications of a wayside or cab signal system, or other similar appliance, method, device, or system of equivalent safety, in a manner by which the PTC system shall provide associated warning and enforcement to the extent, and except as, described and justified in the FRA approved PTCDP or PTCSP, as applicable;

- Section 5.4 Train Movement
- Section 5.4.2 Wayside Signals
- Section 5.4.3 Cab Signals
- Section 5.10.2 Switches in Signaled Territory
- Section 5.10.3 Other Monitored Devices
- Section 5.11 Warning and Enforcement
- Section 5.11.1 Reactive (Overspeed) Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement
- Section 5.11.3 Restrictive Speed Enforcement

(3) As applicable, perform the additional functions specified in this subpart;

(4) Provide an appropriate warning or enforcement when:
(i) A derail or switch protecting access to the main line required by *§ 236.1007*, or otherwise provided for in the applicable PTCSP, is not in its derailing or protecting position, respectively; *{Applies to high speed passenger lines}*

- Section 5.4.2 Wayside Signals
- Section 5.10.3 Other Monitored Devices
- Section 5.11 Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement

(ii) A mandatory directive is issued associated with a highway-rail grade crossing warning system malfunction as required by §§ 234.105, 234.106, or 234.107;

- Section 5.7 Malfunctioning Highway Grade Crossing Warning Systems
- Section 5.11 Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement

(iii) An after-arrival mandatory directive has been issued and the train or trains to be waited on has not yet passed the location of the receiving train;

- Section 5.4.1.1 Track Warrant Control

(iv) Any movable bridge within the route ahead is not in a position to allow permissive indication for a train movement pursuant to § 236.312; and

- Section 5.4.2 Wayside Signals
- Section 5.10.3 Other Monitored Devices
- Section 5.11 Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement

(v) A hazard detector integrated into the PTC system that is required by paragraph (c) of this section, or otherwise provided for in the applicable PTCSP, detects an unsafe condition or transmits an alarm; and

- Section 5.4.2 Wayside Signals
- Section 5.10.3 Other Monitored Devices
- Section 5.11 Warning and Enforcement
- Section 5.11.2 Predictive Warning and Enforcement

(5) Limit the speed of passenger and freight trains to 59 miles per hour and 49 miles per hour, respectively, in areas without broken rail detection or equivalent safeguards.

- Section 5.5.1 Permanent Speed Restrictions
- Section 5.11 Warning and Enforcement
- Section 5.11.1 Reactive (Overspeed) Warning and Enforcement

4 Compliance [§ 236.1011(a)(2)]

4.1 PTCDP, Type Approval, PTCSP, and System Certification

Subpart I §236.1009 sets forth the procedural requirements to fulfill 49 CFR 236, Subpart I, including (a) the PTCIP, (b) the PTCDP and Type Approval, (c) Notice of Product Intent, and (d) PTCSP and PTC System Certification, among other requirements. Norfolk Southern intends to comply with the requirements of §236.1011(a)(2) through the filing of a PTCDP to gain Type Approval and ultimately submittal of a PTCSP in order to obtain PTC System Certification.

On 24 March 2010, Norfolk Southern Railway, CSX Transportation ("CSXT"), and Union Pacific Railroad ("UPRR") jointly filed the Vital Electronic Train Management System (V-ETMS®) Positive Train Control Development Plan with the Associate Administrator thereby eliminating any need for a Notice of Product Intent (NPI). It is expected that FRA will grant Type Approval for V-ETMS as described in the PTCDP.

The design and development of V-ETMS is supported by NS, CSXT, UPRR, as well as other Class I railroads through the Interoperable Train Control (ITC) industry effort. It is the intent of Norfolk Southern Railway to provide the deliverables required by a PTC Safety Plan (PTCSP) as defined in 49 CFR 236, Subpart I, §236.1015. It is expected the PTCSP will be filed by the third quarter of 2011. The PTCSP provides the railroad-specific information demonstrating that the PTC system, as implemented by NS, meets the required safety performance objectives. The PTCSP is the core document that provides the FRA Associate Administrator the information necessary to certify that the as-built PTC system fulfills the required statutory PTC functions and is in compliance with the requirements of Subpart I. Ultimately, FRA PTC System Certification will allow Norfolk Southern to begin deployment of PTC in accordance with this Plan.

4.2 Potential Risks to Finish Date

As with any project of this size and complexity, there are inherent risks associated with it. The Plan must provide the right level of both flexibility and control to allow for successful attainment of goals and objectives. The Project Management Institute, the premiere organization for project management standards and best practices, defines project risk as an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective, such as time, cost, scope, or quality. Identifying, assessing and responding to project risks successfully is a key contributor to project success. Risk management is the process by which we identify, assess, evaluate and mitigate what could go wrong with implementation (the theoretical risks) and plan for the *practical* risks that are likely to happen along the way.

NS will implement a risk management process to identify, mitigate, and monitor risks that could create or suggest increased difficulty in the successful completion and delivery of the PTC system installation on or prior to the required date. This risk management process will:

- Identify risks to meeting the goals and objectives of NS's PTC deployment;
- Predict the consequences associated with risks;
- Implement risk mitigation strategies;
- Monitor risk status; and
- Establish contingency plans.

As risks are identified and prioritized, focus will be applied to those risks that are of high consequence and have a high probability of occurring. These risks tend to be the greatest consumers of resources and time; time is a particularly scarce commodity for the PTC implementation.

Table 4 lists several identified risks to Norfolk Southern Railway's successful completion of PTC installation on or prior to 31 December 2015, the goal or objective at risk, the predicted consequences of the risk should it occur, strategy for mitigation/containment, and contingency plans. This list of risks is intended to capture the risks at a high level, and is not intended to be an all-inclusive list. NS will maintain a risk management process through which additional risks may be identified and existing risks may be closed as PTC installation progresses. Assigned risk numbers are qualitative and do not reflect risk probability or the severity of the risk consequences.

*Table 4. Identified Potential Risks to Norfolk Southern's Completion and Delivery of PTC Installation by December 31, 2015**

Objective/Goal SP	**Safety & Performance: Enhance system safety, with particular focus on the prevention of train-to-train collisions, over-speed derailments, incursions into established work zone limits, and movement of trains through improperly-positioned switches.**
SP-Risk 1	PTC system does not meet design requirements to enhance system safety: V-ETMS does not prevent train to train collisions as designed
SP-Risk 2	PTC system does not meet design requirements to enhance system safety: V-ETMS does not prevent overspeed derailments as designed
SP-Risk 3	PTC system does not meet design requirements to enhance system safety: V-ETMS does not prevent incursions into established work zone limits as designed
SP-Risk 4	PTC system does not meet design requirements to enhance system safety: V-ETMS does not prevent movement of trains through improperly positioned switches as designed
SP-Risk 5	PTC system does not meet design requirements to enhance system safety: Introduces additional safety hazards that reduce system safety
SP-Risk 6	PTC system does not meet design requirements to enhance system safety:

	An acceptable level of safety is not maintained in the development, functionality, architecture, installation, implementation, inspection, testing, operation, maintenance, repair, and modification of the PTC technologies to be deployed
SP-Predicted Consequence 1	PTC system cannot be deployed without modification of system behavior
SP-Predicted Consequence 2	PTC system as developed cannot obtain FRA PTC System Certification
SP-Predicted Consequence 3	Redesign of system
SP-Predicted Consequence 4	Schedule delay
SP-Risk Mitigation 1	Follow system development methodology that captures PTC system requirements and provides traceability throughout the system life cycle
SP-Risk Mitigation 2	Rigorous safety program at all levels of system development
SP-Risk Mitigation 3	Follow methodologies and activities in the PTCSP as required by 49 CFR §236.1015, Appendix B and Appendix C to Part 236
SP-Contingency Plan	Existing method of operation will be utilized until acceptable safety levels have been achieved and FRA PTC System Certification has been granted
Objective/Goal PRBD	**Progressive Risk Based Deployment: Enhancements to system safety will be achieved as a PTC vital overlay system is progressively deployed across all portions of the NS network for which PTC deployment is required by 49 CFR §236.1005(b).**
PRBD-Risk 1	PTC system progressive installation is delayed due to lack of PTC equipment availability
PRBD-Risk 2	PTC system progressive installation is delayed due to lack of availability of resources
PRBD-Risk 3	PTC system progressive installation is delayed due to issues with physical deployment of system on variety of locomotive classes
PRBD-Risk 4	PTC system progressive installation is delayed due to a force majeure event, including acts of God, wars, riots, terrorist event, labor strike, work stoppage, or other slowdown, fires, floods, hurricanes, earthquakes or similar calamity.
PRBD-Risk 5	PTC system progressive installation is delayed due to ineffective coordination of installation causing interference between installation crews where infrastructure is complex and/or working space is limited
PRBD-Predicted Consequence 1	PTC system will not be installed across all portions of the NS network for which PTC deployment is required by 49 CFR §236.1005(b)
PRBD-Predicted Consequence 2	Full benefit of safety enhancements will not be realized by required date
PRBD-Predicted Consequence 3	NS may incur civil penalties

PRBD-Risk Mitigation 1	Develop detailed plans for equipping rolling stock, wayside, and office with required PTC equipment
PRBD-Risk Mitigation 2	Develop detailed training and personnel plans
PRBD-Risk Mitigation 3	Work closely with vendors to minimize risk associated with installation procedures and schedule
PRBD-Risk Mitigation 4	Establish schedule performance metrics to measure PTC deployment progress. Monitor metrics to identify critical path and any potential schedule delays. Take action to avert potential schedule delays
PRBD-Contingency Plan	Existing method of operation will be utilized until acceptable safety levels have been achieved and FRA PTC System Certification has been granted
PRBD-Contingency Plan	In the event negative effects are experienced during PTC deployment impacting safety of operations, network fluidity, or customer service, NS will delay further deployment until issues can be resolved.
Objective/Goal RC	**Regulatory Compliance: PTC deployment will meet the PTC System Certification performance requirements in CFR §236.1015.**
RC-Risk 1	The methodologies and activities as required by 49 CFR §236.1015 are not applied consistently in support of the PTCSP
RC-Risk 2	Gaps in the V&V process that impact the validity of testing results are discovered; at worst, process impairment affects design of the system
RC-Predicted Consequence 1	PTC system does not function as required to meet performance requirements
RC-Predicted Consequence 2	PTC system does not enhance safety
RC-Predicted Consequence 3	PTC system cannot be deployed without modification of system behavior
RC-Predicted Consequence 4	PTC system as developed cannot obtain FRA Certification
RC-Predicted Consequence 5	Massive schedule delay
RC-Risk Mitigation 1	The methodologies and activities as required by 49 CFR §236.1015 will be followed for the PTCSP
RC-Risk Mitigation 2	PTC vendors have an acceptable quality assurance program for design and manufacturing processes
RC-Risk Mitigation 3	Testing and documentation process audits are conducted periodically with vendors
RC-Contingency Plan	Existing method of operation will be utilized until acceptable safety levels have been achieved and FRA PTC System Certification has been granted
Objective/Goal Interop	**Interoperability: NS and its railroads' locomotives will be able to communicate with and respond to the positive train control system, including uninterrupted movements over property boundaries**
Interop-Risk 1	Difficulty and/or delay in establishing required interoperability

	agreements with tenant railroads
Interop-Risk 2	PTC system as built does not meet interoperability design requirements
Interop-Risk 3	Unsuccessful in deploying interoperable radio and messaging technology
Interop-Risk 4	Semantic incompatibility between railroads
Interop-Predicted Consequence 1	PTC system will not be installed across all portions of the NS network for which PTC deployment is required by 49 CFR §236.1005(b)
Interop-Predicted Consequence 2	Full benefit of safety enhancements will not be realized
Interop-Predicted Consequence 3	NS may incur civil penalties
Interop-Risk Mitigation 1	Establish organizational structure to facilitate communication and coordination between host and tenant roads
Interop-Risk Mitigation 2	Participate in industry organizations to establish PTC system standards for interoperability by working collaboratively on requirements definition, system/component design, and product testing to deploy interoperable, common technology
Interop-Risk Mitigation 3	Test to insure that implementation conforms to industry standards
Interop-Risk Mitigation 4	Conduct Interoperability testing
Interop-Risk Mitigation 5	Require adherence to established NS operating and safety rules
Interop-Contingency Plan	Existing method of operation can be maintained until acceptable safety levels achieved and FRA PTC System Certification has been granted.
Objective/Goal SysCov	**System Coverage: All in scope, required segments of the network are fully PTC equipped, operational, and interoperable by 31 December 2015 in alignment with Congressional goal to reduce risk to the public and rail employees.**
SysCov-Risk 1	All required portions of the network are not fully PTC equipped, operational, and interoperable by 31 December 2015
SysCov-Risk 2	Unable to maintain schedule for wayside and locomotive equipping due to impediments to resources or material, weather, terrorism, war, general economic conditions, or additional regulations imposed upon the industry
SysCov-Risk 3	Difficulty and/or delay in achieving required levels of technical interoperability
SysCov-Risk 4	Delay in receiving FRA PTC System Certification due to prolonged regulatory process
SysCov-Predicted Consequence 1	PTC system will not be installed across all portions of the NS network for which PTC deployment is required by 49 CFR §236.1005(b)
SysCov-Predicted Consequence 2	Full benefit of safety enhancements will not be realized by required date
SysCov-Predicted	NS may incur civil penalties

Consequence 3	
SysCov-Risk Mitigation 1	Develop detailed plans for equipping rolling stock, wayside, and office with required PTC equipment.
SysCov-Risk Mitigation 2	Establish clear understanding of technical requirements and schedule for interoperability with each tenant road
SysCov-Risk Mitigation 3	Establish performance metrics to measure tenant progress toward equipping rolling stock with interoperable PTC equipment
SysCov-Risk Mitigation 4	Meet requirements of RSIA08
SysCov-Contingency Plan	Existing method of operation will be utilized until acceptable safety levels have been achieved and FRA PTC System Certification has been granted
SysCov-Contingency Plan	In the event negative effects are experienced during PTC deployment impacting safety of operations, network fluidity, or customer service, NS will delay further deployment until issues can be resolved.
Objective/Goal OE&SR	**Operating Efficiency & System Reliability: NS will maintain acceptable levels of operating efficiency on districts operating under PTC.**
OE&SR-Risk 1	Unacceptable train delays are incurred as a result of PTC operation
OE&SR-Risk 2	PTC implementation and/or system design introduces inefficiencies due to wireless communication-related delays
OE&SR-Risk 3	PTC implementation and/or system design introduces inefficiencies from inefficient train operation resulting from braking algorithm
OE&SR-Risk 4	Reduction in efficiency resulting from running unequipped trains through PTC equipped territory because locomotives operating with PTC equipment installed have suffered equipment outages
OE&SR-Risk 5	Reduction in efficiency resulting from running unequipped trains through PTC equipped territory because trains are not PTC-equipped
OE&SR-Risk 6	Reduction in efficiency of human capital due to ineffective human factors design for PTC equipment
OE&SR-Risk 7	Reduction in efficiency of human capital due to ineffective and/or insufficient training of personnel
OE&SR-Predicted Consequence 1	Railroad network incurs unacceptable train delays as a result of PTC
OE&SR-Predicted Consequence 2	PTC deployment is delayed until issues are resolved
OE&SR-Predicted Consequence 3	Labor claims or issues arise as a result of operating inefficiencies
OE&SR-Risk Mitigation 1	Reliability program initiated to monitor, report, and improve reliability of equipment
OE&SR-Risk Mitigation 2	Identify and reach agreement with tenants for equipping with PTC equipment
OE&SR-Risk Mitigation 3	Monitor training and institute quality improvement program

OE&SR-Risk Mitigation 4	System development effort focusing on high technical risk areas to identify and mitigate potential system design and implementation-related contributions to decreased productivity
OE&SR-Contingency Plan	In the event negative effects are experienced during PTC deployment impacting safety of operations, network fluidity, or customer service, NS will delay further deployment until issues can be resolved.

* *This list of risks is intended to capture the risks at a high level, and is not intended to be an all-inclusive list.*

5 Interoperability [§236.1011(a)(3)]

This section describes how the PTC system deployed by NS will provide for interoperability between the host and all tenant railroads on the NS line segments required to be equipped with a PTC system per Part 236 Subpart I. 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. Interoperability as defined in RSIA08 means, "The ability to control locomotives of the host railroad and tenant railroad to communicate with and respond to the positive train control system, including uninterrupted movements over property boundaries." Interoperability is achieved through four interrelated means: product testing, industry and community partnership, common technology and intellectual property, and standard implementation.

5.1 Railroad Agreement Provisions Relevant to Interoperability [§236.1011(a)(3)(i)]

Norfolk Southern has been a leading signatory to the interoperability train control collaboration agreement and has worked tirelessly with its industry colleagues on "the project"- the development of an interoperable train control system which will enable locomotives from one participant to transition at track speed to the control of another participant. (This effort is more fully described below). In creating this PTCIP, Norfolk Southern has evaluated the track segments identified for PTC deployment as required by Subpart I and identified affected tenant railroads operating on those segments. Norfolk Southern has established a dialogue regarding PTC implementation and plans for obtaining interoperability and successfully executed an agreement to achieve interoperability with the following tenants with operations on Norfolk Southern Railway on PTC line segments for implementation:

- Allegheny Valley Railroad
- BNSF Railway Company
- Camp Chase Industrial Railroad
- Canadian National Railway Company
- Canadian Pacific Railway Company
- Commuter Rail Division of the Regional Transportation Authority, Northern Illinois Regional Commuter Railroad Corporation (METRA)
- CSX Transportation, Inc.
- Georgia Southern Railroad
- Indiana Northeastern Railroad Co.
- Kansas City Transportation Company LLC
- Lycoming Valley Railroad
- National Railroad Passenger Corporation (Amtrak)
- New York Susquehanna & Western Railway
- North Carolina Department of Transportation
- North Shore Railroad Company

- Terminal Railroad Association of St Louis
- The Kansas City Southern Railway Company
- Union Pacific Railroad Company
- Virginia Railway Express (VRE)
- Wheeling and Lake Erie RR

NS has executed a Memorandum of Understanding (MOU) with each of these carriers. A sample MOU (and the MOU with the ITC carriers) is included in *Appendix A: Interoperability Agreements* for reference. The document establishes agreement between NS and its tenants regarding:

- Implementation of PTC technical solutions which meet the requirements of interoperability as defined in §236.1003(b)
- NS's plan to deploy the Wabtec V-ETMS PTC system which is designed to support interoperability
- NS's plan to utilize 220 MHz spectrum for communication functions of radios and wayside interface units
- Participation in a PTC testing program to verify functionality and interoperability, and
- Exchange of technical information needed to implement PTC in accordance with applicable FRA requirements.

Norfolk Southern believes its proffered MOU is consistent with §236.1001(b) and the agreements under which tenant railroads operate on NS line segments.

5.2 Methods to Achieve Interoperability [§236.1011(a)(3)(ii)]

Norfolk Southern Railway and its interoperability partners utilize three methods to obtain and maintain interoperability of its PTC system(s):

Technical interoperability is achieved through the common use of documented interface definitions. These definitions include one or more radio protocols (220MHz) and hardware interfaces to radio equipment, a common standard messaging protocol (ITC Messaging), and standard data element and application message format and content definitions (V-ETMS interface control documents). These interface standards include message formatting, data integrity, use of a data dictionary, quality of service, and message data content. Use of and compliance with these common interface definitions insures the ability to exchange data messages between interoperable system components.

Norfolk Southern Railway achieves interoperable PTC operations with each tenant railroad that operates PTC systems *on NS line segments* through

Native Interoperability. NS and its interoperability partner both install and operate Vital Electronic Train Management® System (V-ETMS) on their respective locomotives, office, and wayside. By design, V-ETMS provides for full functionality for any equipped locomotive, regardless of ownership, with any office or wayside correspondingly equipped. Interoperability is achieved through native operation of V-ETMS without the need for data, function, or human-machine interface (HMI) translation. Interoperable communications are achieved through adoption of the common communications and message protocols, and application behavior specifications described in ITC interoperability requirements. The V-ETMS design encompasses the methods of operation and rules of both NS and its interoperability partner and accommodates any differences in the data provided by back office systems. V-ETMS and its operations are fully described in the Vital Electronic Management System Positive Train Control Development Plan (PTCDP), submitted to FRA on March 24, 2010.

For reference only as this does not refer to tenants operating on NS lines, Norfolk Southern and *its* host railroads will also utilize an additional method to achieve interoperability on *host lines where NS is a tenant*. This method currently will not be required on NS operated tracks but rather on tracks belonging to other host railroads where NS is the tenant. This method may be referred to as:

Dual Equipping Interoperability. In certain locations where NS is the tenant on another host's railroad, Norfolk Southern Railway operates V-ETMS and its interoperability partner operates a different resident PTC system. For track where both party's trains operate, the necessary wayside infrastructure will be installed to support trains equipped with either PTC system. Locomotives will only be equipped with one of the PTC systems. Interoperability is achieved by allowing the equipped locomotive to operate with its compatible PTC office and wayside infrastructure deployed along the track segment.

Semantic interoperability is achieved through the common use of documented system behavioral specifications. In October of 2008, an Interoperable Train Control (ITC) collaboration agreement was executed by and among NS and three Class I railroads (BNSF, CSXT, and UPRR) wishing to achieve Positive Train Control (PTC) system interoperability through, in part, the development of an interoperable train control system which would enable locomotives of one participant to transition at track speed to the control of another participant.

Canadian National Railway Company (CN), Canadian Pacific Railway Company (CP), the National Railroad Passenger Corporation (Amtrak) and The Kansas City Southern Railway Company (KCS) have been active participants on many of the ITC technical teams although not formally signatory to the ITC collaboration agreement. Through technical team activities, each has been a participant and is aware of the developments taking place. Each has access to the applicable

specifications, and as is evident in their PTCIP filing, is confident that there is no impediment to adopting the standards and technology arising from this ITC effort to achieve interoperability.

From a segment viewpoint, standards have been developed by the parties involved for:

- Locomotive to wayside communication,
- Locomotive to back office communication,
- Locomotive on board system behavior, and
- Locomotive on board displays

The ITC collaboration agreement includes a list of interoperability requirements mutually agreed-to by NS, BNSF, CSXT and UPRR:

- Definition and adoption of uniform interface standards;
- Definition, adoption and implementation of AAR-standard communications protocols;
- Definition, adoption, and implementation of common office-locomotive communications protocols and message formats;
- Definition, adoption, and implementation of a common Human Machine Interface, allowing the train crew from any of the participant's roads to utilize the system on any participant's locomotives on territory for which the train crew is qualified;
- Adoption of a coordinated plan for configuration management of the interoperable PTC onboard executable software;
- Agreement on use of railroad-owned radio spectrum in the 220MHz band for communications between the locomotive and wayside and the locomotive and back office;
- Agreement to acquire, develop and deploy all of the technical capabilities required to permit the use of shared communications infrastructure; and
- Definition and adoption of standards allowing each participant's train crew, at the start of a trip, to initialize the interoperable onboard system with the back offices of any participant's PTC systems which may be traversed during the trip to support all interoperability scenarios which will be encountered on the line-of-road with respective locomotive fleets and run-through operations.

In the current ITC architecture, standard application-level specifications define the behavior of the interoperable office, locomotive, and wayside segments. Use of and compliance with these common behavioral specifications insures each interoperable system segment properly interprets and acts upon exchanged data messages.

Organizational interoperability is achieved primarily through industry-wide forums, such as committees chartered by ITC and AAR. Technical teams operating under both the ITC and AAR charters are tasked with developing and maintaining the common technical standards in the areas of technical and semantic interoperability previously described. The ITC collaboration agreement established project management and governance through an executive, steering and working committee which oversaw the formation of seven technical committees, each

dedicated to different but interrelated technical aspects of PTC interoperability. Participation in the technical working committees has included other railroads planning to implement an interoperable PTC system and wishing to participate. These teams have worked to establish a baseline level of interoperability required for industry-wide PTC implementation. The teams will work in perpetuity to provide configuration management and insure that interoperability is maintained as the interoperable PTC system(s) are enhanced. Norfolk Southern Railway is party to the ITC collaboration agreement and is a participant on all ITC technical teams, committing a dozen resources to the yearlong ongoing effort to resolve interoperability obstacles and institute industry standards for PTC development. ITC and AAR teams also work to establish organizational interoperability in the areas of interchange and infrastructure sharing.

Norfolk Southern fosters interoperability with other PTC equipped railroads through an ongoing dialogue with each entity. As a member of the ITC consortium, NS has an active dialogue with the other three member railroads as well as other participants. This dialogue is wide ranging and covers many organizational areas. In addition, as each tenant railroad or interchange partner requiring PTC interoperability has been identified, appropriate points of contact have been named and a dialogue initiated. In many cases, more than one point of contact has been identified within each organization to more effectively match areas of organizational responsibility. Interoperability is supported through the establishment of the appropriate points of contact and an open line of communication between organizations. Finally, NS has designated a liaison, Manager Regulatory Compliance & Training, to serve as a primary point of contact and ensure organization communications flow with regard to PTC interoperability matters with each of its tenant railroads.

5.3 Interoperability Next Steps and Obstacles [§236.1011(a)(3)(iii)]

As of the date of this filing, NS has not received an executed Memorandum of Understanding as described in Section 5.1 from some tenant railroads. It is hopeful that NS and these tenant railroads will be able to reach agreement, but due to the short timeline between the 15 January 2010 release of the final rule for Subpart I, the identification of the PTC line segments for NS, the mailing of the letters to the tenants with NS's requirements, and the PTCIP filing deadline, all parties have been unable to review and process the necessary forms. Additionally, some of the NS tenants in taking issue with executing the MOU for PTC Interoperability have noted a desire to amend their trackage rights agreements with NS or to continue further discussions to reach an alternative arrangement for interoperability. Others have inferred that Subpart I and RSIA08 do not require PTC for their operation on Norfolk Southern Railway. Norfolk Southern operating rules will require that any locomotive operating on PTC equipped track be fully and functionally PTC interoperable.

The following Norfolk Southern tenants have not executed an interoperability agreement with Norfolk Southern Railway as of the date of this filing:

- Alabama & Gulf Coast Railway, LLC

- Buffalo & Pittsburgh RR
- Chattooga & Chickamauga Railway Co.
- Chicago, Fort Wayne & Eastern Railroad
- Columbus & Ohio River Railroad
- Commonwealth Railway Inc.
- Dubois County Railroad
- Georgia & Florida Railroad
- Georgia Southwestern Railroad Company, Inc.
- Grand Elk Railroad
- Indiana & Ohio Railway
- Indiana Harbor Belt Railway
- L&N RR c/o Regional Rail LLC
- Ohio Central System
- Ozark Valley Railroad Inc.
- Paducah and Louisville RR
- Reading, Blue Mountain & Northern RR
- RJ Corman RR Company
- Rochester & Southern Railroad
- Tennessee Valley Railroad Museum
- Wabash Central, LLC
- Western New York & Pennsylvania Railroad, LLC
- Youngstown & Southeastern Railroad

Norfolk Southern has followed up with its tenant roads that had not yet responded as of April 16, 2010. NS will continue to attempt to engage its tenants in an interoperability dialogue. For those tenants who have responded but who have offered alternative arrangements to equipping of their locomotives, Norfolk Southern will continue to engage in interoperability discussions and identify obstacles to agreement in order to achieve the desired result of reaching an interoperable solution. NS will provide the FRA updates on the progress of reaching agreements or conversely, obstacles to agreement. This Plan will be updated to reflect current tenant status simultaneously with other changes that are made which require a RFA. A discussion of locomotive equipping requirements can be found in Section 9.4 Tenant Railroads and its related *Appendix A-1: Tenant Railroad Responses Locomotive Equipping*.

6 Designating Track as Main Line or Non-Main Line [§ 236.1011(a)(8)]

6.1 Mainline Designation

Norfolk Southern Railway's owned and operated rail network encompasses 16,500 route miles and is characterized by three transportation regions, further divided into 13 operating divisions. Each division on NS is partitioned into line segments or districts. The number of line segments or districts varies by division but in total there are 562 line segments or districts on Norfolk Southern Railway.

NS's rail network is comprised of mainline and non-mainline tracks. As per Subpart I, §236.1003, *Main line* is defined as:

> *Main line* means, except as provided in §236.1019 regarding Mainline Track Exceptions or where all trains are limited to restricted speed within a yard or terminal area or on auxiliary or industry tracks, a segment or route of railroad tracks:
> (1) Of a Class I railroad, as documented in current timetables filed by the Class I railroad with the FRA under 49 CFR § 217.7, over which 5,000,000 or more gross tons of railroad traffic is transported annually; or
> (2) Used for regularly scheduled intercity or commuter rail passenger service, as defined in 49 U.S.C. 24102, or both.

Thusly, Norfolk Southern Railway identifies 235 line segments as Main line as they meet the requirement of being a segment or route of railroad tracks over which 5MGT of traffic was transported in 2008 or are used for regularly scheduled intercity or commuter rail passenger service, or both.

Norfolk Southern Railway identifies 327 line segments as non-mainline as they do not meet or exceed the 5MGT threshold or they are not used for regularly scheduled intercity or commuter rail passenger service, or both.

Appendix B: Mainline Designation provides a complete listing of Norfolk Southern Railway's line segments and its mainline/non-mainline qualifying attributes. A description of the fields in Appendix B follows:

- Line ID: Internal NS designation of line segment combining Division and District identification
- Division: An operating designation of territory supervised by a Superintendent
- District: A portion of an operating division designated by timetable. Districts are supervised by trainmasters.
- Line Segment from/to: Generally the operating stations for the beginning and ending of a line segment
- Low MP: The beginning milepost for a line segment

High MP: The ending milepost for a line segment
District Miles: The sum of the miles from beginning milepost to ending milepost on the designated segment of track
Mainline Low MP: The beginning milepost for the mainline as defined by the Subpart: equal to or greater than 5MGT annual volume and/or regularly scheduled intercity commuter or passenger service on the line
Mainline High MP: The ending milepost for the mainline as defined by the Subpart: equal to or greater than 5MGT annual volume and/or regularly scheduled intercity commuter or passenger service on the line
Non-mainline Low MP: The beginning milepost for non-mainline segment as defined by the Subpart: less than 5MGT annual volume, no passenger service or intercity commuter service on the line, or where all trains are limited to restricted speed within a yard or terminal area or on auxiliary or industry tracks
Non-mainline High MP: The ending milepost for non-mainline segment as defined by the Subpart: less than 5MGT annual volume, no passenger service or intercity commuter service on the line, or where all trains are limited to restricted speed within a yard or terminal area or on auxiliary or industry tracks
Mainline Mileage: Total mainline designated miles
Non-mainline Mileage: Total non-mainline designated miles

No tracks are designated for MTEA exception based upon the annual MGT and passenger service traffic as per §236.1019(c)(3).

7 Installation Risk Analysis [§ 236.1011(a)(4)]

7.1 Overview

This section describes the risk prioritization model generated in response to 49 CFR Part 236 Subpart I §236.1011(a)(4), which requires that, to the extent practical, the positive train control (PTC) system be implemented to address areas of greater risk to the public and railroad employees before areas of lesser risk. Due to the shortened time frame available to construct the risk prioritization model, NS and several other Class I railroads gathered experts to develop a model for use by the industry. The results of this group effort are reflected in the methodology and documentation included in *Appendix C: Installation Risk Analysis* and the process outlined in the following section. NS applied the methodology in selection of risk factors for inclusion in the prioritization model; assignment of factor levels; and determination of weighting associated with each risk factor included in the model.

7.2 Methodology

Estimation of Risk Factor Weights

Ideally, risk factor weights would have been assigned based on detailed computations, using a probabilistic risk assessment (PRA) with sensitivity analyses, or by performing regression analyses of historical data, for example. Unfortunately, such detailed computations could not be achieved in the required timeframe, as the final rule of 236 Subpart I was issued on 12 January 2010, and submission of the *Positive Train Control Implementation Plan (PTCIP)* was required by 16 April 2010. Completion of the risk prioritization exercise was required well in advance of the 16 April 2010 deadline since the results of this exercise would heavily influence other planning-related components of the PTCIP.

Since time was not available for a detailed study and no other quantitative information was identified as appropriate for direct application as risk factor weights, the estimation of risk factor weights relied heavily on expert judgment. While it was NS's intent to have the best available expert(s) within the organization provide these judgments, discussions with the other six North American Class I railroads resulted in an agreement to collaborate on these estimates so that the expertise of others could be taken into consideration, thereby augmenting NS's expertise. Although considerable weight was given to the input received from the other railroads, NS's final risk factor weights were assigned, keeping the weights' specific applicability to NS's line segments in mind.

The experts that were considered most qualified to provide the necessary judgments were representatives from the seven North American Class I railroads with significant expertise in railroad operations. Their detailed understanding of how the railroads operate and their familiarity with the various risks involved in railroad operations made these individuals the

most qualified to provide these judgments. The possibility of performing formal individual interviews of these experts, using an elicitation approach based on the approach outlined in US Nuclear Regulatory Commission Regulation 1150 (NUREG-1150) was considered, but it was decided that such an approach was not ideally-suited for quantification of these risk factor weights. This was primarily due to the fact that the risk factor weights are "high level" and rather abstract quantities, whereas formal elicitations are generally more effective when eliciting quantities at a "lower level" (for example, asking experts to quantify the probability that a train operator fails to obey a restrictive signal indication may be an estimate that is more effectively elicited in a formal elicitation setting). Also, while those deemed most suitable to estimate risk factor weights were personnel from the railroads with significant expertise in railroad operations, these experts were not necessarily experts in risk assessment, so it was recognized that additional collaboration among railroad operations experts and risk assessment experts would be beneficial. Lastly, the time limitation in performing the risk prioritization exercise also presented a challenge, as a more formal elicitation process would have required several weeks to conduct. As a result, it was decided that a more collaborative/group-oriented approach be taken, with experts in risk assessment interacting with railroad operations experts in estimating risk factor weights in a less-formal setting.

Although a formal elicitation approach such as that documented in NUREG-1150 was not followed, some aspects of this type of approach were implemented, wherever feasible. Some key topics that would normally be discussed during an elicitation kick-off/training meeting were covered with the railroad operations representatives, they were made aware of a number of common pitfalls that may be encountered when providing expert judgments, including susceptibility to various types of biases and also weaknesses related to providing estimates in a group setting.

Among the primary biases of concern in this exercise was the "anchoring" bias, which refers to the tendency of starting with an initial estimate and failing to move from that estimate. In the case of risk factor weights, a potential source of anchoring bias was the *Risk Prioritization Template*, as many of the representatives could have potentially been biased by the weighting values included in this document even though the FRA had indicated that the values in the template were for illustrative purposes only. Another type of bias that the experts were made aware of was the "availability" bias, which is the tendency to give too much weight to easily accessed or remembered information. An event receiving much attention often may result in a similar event being given a higher probability of occurring. For example, it is possible that one or more of the risk factors could have contributed significantly to a recent accident that is fresh in the minds of the experts, thereby creating the potential for them to give extra weight to that factor. The respondents were cautioned that, while all relevant information should be taken into consideration when providing estimates, they should take care not to provide too much weight to something due to the fact that it stands out in their minds simply due to the fact that it was a recent occurrence.

While there are other types of biases that provide a challenge when eliciting expert judgments, one final bias identified as a particular concern in performing an activity such as this is the "motivational" bias. This bias is related to consciously providing judgments that do not reflect the expert's true beliefs, which could result when the expert has an economic, political or other stake in the results of the assessment. While this is not at all to suggest that any of the respondents involved in this exercise expressed this bias, this was addressed to make the individuals aware this type of bias is possible. It is thought that one of the most effective ways to eliminate biases, after all, is to be aware of their potential to exist.

In addition to the various biases described above, other topics that were discussed with the experts prior to estimating risk factor weights were the advantages and disadvantages of the group discussions that took place during this process. In general, group discussions provide an opportunity to take advantage of the collective experience of the individual members of the group. Being able to draw upon the different experiences of multiple experts can be quite valuable and allows different perspectives to be taken into consideration. The group setting can also lead to significant synergy, as ideas of the group may form a greater whole than the sum of individual ideas. The group setting also comes with some disadvantages, however, and similar to the different types of biases, it was thought that the best way to address, and to the extent possible, minimize the disadvantages of group discussion, was to be aware of their potential to exist. Among the identified disadvantages are the potential for discussions to be dominated by one or only a couple of members of the group, the potential for group members to bias other group members, the potential for polarized opinions to create extra complexity, and also the potential for "groupthink." Detailed discussions of these and other related topics are widely available in a number of sources.

Another key topic that was discussed with the railroad operations experts, which is important to note here, is the fact that there would likely be a significant amount of uncertainty in their estimates, meaning that there would be significant uncertainty in the final risk factor weights, and ultimately a great deal of uncertainty in the priority with which NS line segments should be equipped with PTC. Even if the risk factor weights could have been arrived at through intensive computations, such as PRA or regression analyses, results of such computations would also come with a great deal of aleatory and epistemic uncertainty. While quantitative expression of uncertainty is often recommended when estimating quantities and generating risk results (primarily so that those making decisions based on the results can take the level of uncertainty into account), whether in the form of distributions, confidence intervals, or similar, the uncertainty was not quantified in this risk prioritization model.

The *Risk Prioritization Template* provided by FRA was provided to offer guidelines for assessing the prioritization with which segments should be equipped, and it was assumed that these guidelines provided a reasonable indication of the level of detail that the FRA was expecting to see in the railroads' risk prioritization models. The *Risk Prioritization Template* did not seem to indicate that quantification of uncertainty would be expected in the risk prioritization model,

and therefore, no attempts were made to quantify the uncertainty in the results. Since the results of the risk prioritization are presented as risk scores, with no error bars or similar, it is important for those using the results in their decision-making process (in this case, personnel at NS who will decide the sequence with which line segments should be equipped) to understand that there is a significant amount of uncertainty in these results. The results should be interpreted as "best estimates" of rail operations experts, with the understanding that there is a good deal of uncertainty in these estimates.

Ultimately it is important to consider the purpose of the Risk Prioritization effort. The result of this model will be applied to identify the relative order of PTC deployment. It does not impact the selection process for PTC line segments to be deployed. The criteria applied for the selection process are defined in the regulation and are not subject to interpretation by the railroad. Therefore, the Risk Prioritization effort has no effect on the scope of PTC deployment, but only on the ordering of deployment to identify line segments with relatively higher risk to be deployed before line segments with relatively lower risk. As a result, this Risk Prioritization effort focused on inclusion of the factors associated with the significant hazards which PTC systems are able to mitigate.

Definition and Assignment of Risk Factor Levels

A discussion of each of the risk factors identified for inclusion in the model is provided in Section 3.0 of Appendix C-1. Included with the discussions of each risk factor are the definitions of the various scoring levels (from 0 to 5) that were used to rate the line segments for each risk factor. In general, risk factor levels were defined by looking at the range of data for a risk factor across all line segments and assigning factor levels that were typically evenly-spread between the minimum and maximum values of the data and adjusting slightly for the purposes of normalizing the mileage or percentage of track (with respect to a particular risk factor) as warranted.

The upper and lower limits of each scoring level are defined in tables for each factor in Appendix C-1. Where applicable, plots of available NS risk factor data, which show the distribution of line segments among the factor levels defined for each risk factor, are also provided.

The data that were used for the risk factors for each of the NS line segments included in the risk prioritization model were collected from the appropriate departments within NS. These data were also used in creating the risk ranking and order of PTC deployment and are included in Appendices B and C. Data were converted, as necessary, to be compatible with the factor levels that were defined for each risk factor so that the NS line segments could be assigned a score (also referred to as 'Risk Factor Levels') for each of the risk factors. Section 3.0 in Appendix C-1 provides additional information on the risk factor levels that were defined for each risk factor and describes how the data were used to quantify the various risk factors included in the risk prioritization model.

7.3 Risk Factors Included in Risk Prioritization Model

The Content of This Section Has Been Redacted

7.4 Risk Factors Weighting and Risk Level

The Content of This Section Has Been Redacted

7.4.1 Annual Million Gross Ton (MGT) Levels

The Content of This Section Has Been Redacted

7.4.2 Presence and Volume of Passenger Traffic

The Content of This Section Has Been Redacted

7.4.3 Presence and Volume of TIH/PIH Material (Loads and Residue) Transported

The Content of This Section Has Been Redacted

7.4.4 Number of Tracks

The Content of This Section Has Been Redacted

7.4.5 Method of Operation

The Content of This Section Has Been Redacted

7.4.6 Speed of Train Operations

The Content of This Section Has Been Redacted

7.4.7 Track Grades

The Content of This Section Has Been Redacted

7.4.8 Track Curvature

The Content of This Section Has Been Redacted

7.5 Norfolk Southern Rail Network Description

Norfolk Southern Railway's owned and operated rail network encompasses 16,500 route miles and is characterized by three transportation regions, further divided into 13 operating divisions. They are the:

Region	Divisions
Eastern	Delmarva Business Unit
	East Carolina Business Unit
	Piedmont
	Pocahontas
	Virginia
Northern	Dearborn
	Harrisburg
	Lake
	Pittsburgh
Western	Alabama
	Central
	Georgia
	Illinois

Each division on NS is partitioned into line segments or districts. The number of line segments or districts varies by division, with as few as 15 on the Delmarva Business Unit to as many as 99 on the Harrisburg division with the average of 45 districts on a division. The length of the line segments also varies as would be expected. Some segments are less than a mile in length; with

the longest segment covering over 600 miles on the Piedmont division. Each line segment is described by a name, usually a station to/from designation. Each district also has a finite beginning and ending milepost designation.

The PTC risk methodology described in detail in this section was performed to assess the applicability of requirements for PTC for every one of NS's line segments represented in its track charts.

Once the 2008 traffic data was compiled for the network, the attributes for the line segments were assigned. The risk methodology formulas were applied, and the results tabulated to determine applicability for PTC implementation.

7.6 Risk Prioritization Calculation

The Content of This Section Has Been Redacted

8 Deployment Sequence and Schedule [§ 236.1011(a)(5)]

This section describes the PTC line segment sequence, planned schedule, and decision basis for line segment sequencing, including the identified risk ranking by line segment. As described in Section 7, a risk ranking number was developed for each line segment where PTC is scheduled to be deployed. This ranking represents the weighted average of considered risk factors over the entire distance of the line segment. A statistical analysis of the distance weighted distribution of the ranking was performed to identify three relatively equal tiers or "pools" of PTC deployment. By establishing these three tiers, NS is better able to manage its PTC deployment and mitigate some of the risks identified in Section 4.2. For example, availability of resources, labor agreement constraints, and risk of delay due to weather are several risks which are possibly mitigated through the creation of PTC deployment pools by allowing for flexibility in staging and scheduling of installation work to be performed. The risk ranking is the primary factor in consideration of the installation plan. With that in mind, subsequent factors used to methodically plan a tier deployment are utilized: within a tier, BRS resource availability must provide for adjoining line segment wayside construction and installation; crew districts must be factored in to provide for contiguous training and operations for progressive deployment; the PTC-enhanced CAD system must be fully deployed and operational on each division; and, the railroad's operations should be marginally impacted with the deployment. These factors and others are assessed in the sequencing to achieve incremental improvements in PTC coverage.

Evaluating the ranking data across the NS PTC deployment by analyzing the distribution of data values on a per mile basis provided the means to identify the thresholds for the ranking levels associated with each tier of deployment. The tier thresholds were determined based on assigning levels to represent relatively equal percentages of the total PTC deployment track mileage. Although the limits for the overall risk may appear as broad as 2.4 points in Table 8, the actual variance between the deployment tiers' high and low risk limits, as seen in the Appendix C "Rank" column, is fairly small and equal, with the variance between the min and max values of tier 1 at 1.17; for tier 2, a range of .52, and the variance between max and min for tier 3 is 1.08. This further illustrates a consistent application of the methodology across each tier and grouping of line segments and relative equal overall risk within a tier of deployment.

Table 8. Tiers of NS PTC Deployment

Tier	Lower Limit Rank	Upper Limit Rank	% of NS Track
Tier 3	0	<=2.428	33.1%
Tier 2	>2.428	<=2.968	33.8%
Tier 1	>2.968	5.0	33.1%

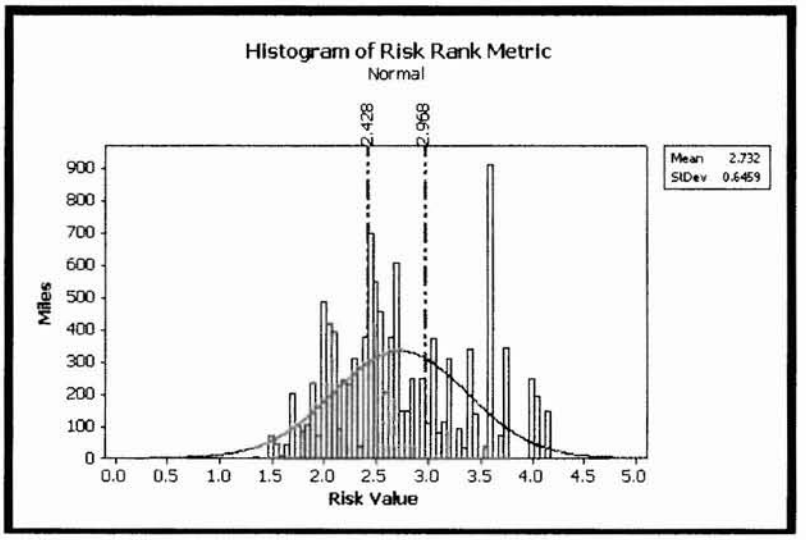


Figure 8. NS PTC Deployment Tiers

It is NS's intention to deploy the line segments according to their tier designation beginning with those in tier 1. As the line segments associated with tier 1 are completed, work will progress to the line segment identified in tier 2 and ultimately to tier 3. This work will be performed in accordance with the details as described in this Plan. As was detailed in Sections 1.2 Goals and Objectives regarding Progressive Risk Based Deployment and 1.3.1.1 for System Coverage, NS plans to implement PTC based on a 3 tier deployment distribution to attain incremental improvements in PTC coverage and to achieve safety benefits of PTC through progressive equipping of controlling locomotives operating on PTC lines through the System Coverage goal:

Year	*Total Route Miles Implemented*
2011	Dependent upon PTC System Certification
2012	20 - 35%
2013	50 - 65%
2014	75 - 85%
2015	100%

The details regarding each line segment and the corresponding deployment factors are found in *Appendix C: Installation Risk Analysis* as introduced in Section 7. Columns labeled, "PTC From MP" (the beginning milepost for PTC deployment on the line), "PTC To MP" (the ending milepost for PTC deployment on the line), "PTC Miles" (the total number of deployment miles per segment), and "Deployment Tier" are specific to the deployment sequence and schedule.

8.1 Segment Traffic Characteristics [§ 236.1011(a)(5)(i)]

Traffic on Norfolk Southern's Main Lines varies by segment. The methodology employed to evaluate risk as described in Section 7 took into account the attributes of each line segment, broken down to a node level. The segments were then distance weight averaged to determine a rank for each attribute. Traffic characteristics included in the evaluation are annual million gross tons (MGT) of traffic (Section 7.4.1), presence and volume of passenger traffic (Section 7.4.2), and volumes of TIH/PIH commodities (Section 7.4.3) during calendar year 2008. These specific characteristics associated with each line segment are provided through the related Risk Factor level captured in Appendix C. As these characteristics vary over each line segment, it was determined that the distance weighted average Risk Factor level was the most concise way of capturing and describing these segment traffic characteristics. The distance weighted average provides a proportional relevance of each node based on its actual length rather than treating each node equally. Use of a basic average applied across a line segment would not have accounted for the variances in the characteristics across a line. Each node had characteristics described in Section 7 applied and risk ranked. Each factor was then "multiplied" by the distance of the node to create a distance weighting. All nodes were then calculated for the total length of the line segment and then an average for each risk factor applied across that line's distance. Using this method allows each node to contribute to the risk calculation proportional to its distance.

NS has also identified line segments which may not require PTC deployment under the traffic change and de minimis provisions included in Section § 236.1005(b)(4)(ii) of the final PTC rule. This section allows Norfolk Southern to request review of the requirement for installation of PTC based on 2008 traffic data when traffic levels drop below the defined PTC threshold, upon cessation of PIH traffic, and/or low density line segments. As of the time of this filing, the FRA has established a "PTC Risk Evaluation Task Force" to define the requirements for a "PTC Route Comparative Analysis Support Tool." FRA expects this tool to support the analysis required in Section § 236.1005(b)(4)(ii). Until the task force completes its work and a methodology is established to determine the comparative risk, NS is providing the inventory of line segments it believes will be eligible for removal from this Plan in *Appendix C-2: Anticipated Modifications to Traffic Characteristics.* The category column in Appendix C-2 labeled "Application" denotes whether NS expects the line segment to be applied to the cessation of PIH traffic ("Network Optimization") or de minimis ("De Minimis") provisions or possible inclusion in both categories. NS shall provide supporting risk analysis at a future date as required for each exclusion sought under § 236.1005(b)(4).

8.2 Segment Operational Characteristics [§ 236.1011(a)(5)(ii)]

Operational characteristics on Norfolk Southern's Main Lines vary by segment. The methodology employed to evaluate risk as described in Section 7 takes into account the operational characteristics of each line segment, broken down to a node level. The segments were then distance weight averaged to determine a rank for each attribute. Operational

characteristics included in the evaluation are number of tracks (Section 7.4.4), method of operation (including the presence or absence of a block signal system) (Section 7.4.5), and maximum allowable train speeds (Section 7.4.6). These specific operational characteristics associated with each line segment are provided through the related Risk Factor level captured in Appendix C. As these characteristics vary over each line segment, it was determined that the distance weighted average Risk Factor level was the most concise way of capturing and describing these segment operational characteristics.

As required by the regulation, NS has identified planned modifications which will impact the characteristics described under this section. Upon evaluation of each of these modifications and adjustments to the line segments' associated risk rankings for the factor(s) affected by the modification, the total risk rank for the line segment will be recalculated. The initial assessment has shown that these projects are expected to either have a negligible net effect or a positive impact on the risk ranking for the affected line segments designated to receive PTC which will allow the planned deployment schedule to remain as planned. The list of identified planned modifications known to NS is provided in *Appendix C-3: Planned Modifications to Operational Characteristics* with a brief description. NS will provide further analysis to support any RFA these network enhancements might require.

8.3 Route Attributes [§ 236.1011(a)(5)(iii)]

Route attributes on Norfolk Southern's Main Lines vary by segment. The methodology employed to evaluate risk as described in Section 7 took into account the route attributes of each line segment, broken down to a node level. The segments were then distance weight averaged to determine a rank for each attribute. Route attributes included in the evaluation are number of ruling grade (Section 7.4.7) and extreme curvature (Section 7.4.8). These specific route attributes associated with each line segment are provided through the related Risk Factor level captured in Appendix C. As these attributes vary over each line segment, it was determined that the distance weighted average Risk Factor level was the most concise way of capturing and describing these route attributes.

9 Rolling Stock [§ 236.1011(a)(6)]

This section contains information related to the Norfolk Southern Railway rolling stock that will be equipped with PTC technology.

As of March 1, 2010, the NS locomotive fleet consisted of a total of 3,756 locomotives. The active locomotive fleet at any given time can vary depending on the current traffic levels and operating service plan requirements. In developing its PTC Implementation Plan, NS reviewed its overall locomotive fleet assignments, fleet age, and operating service plan to determine the best strategy for meeting PTC objectives. Norfolk Southern's primary objective in establishing the plan for equipping locomotives is to ensure a sufficient pool of locomotives for PTC operation on equipped line segments both during PTC deployment and beyond the 12/31/2015 deadline. While NS plans to install PTC on the vast majority of its locomotive fleet, all locomotives are not required to be equipped. NS will continuously evaluate the operational demands of its rail network for the current traffic levels and distribution of car loads to determine the proper level of PTC equipping. As described in Section 1.3.1.2.1, Norfolk Southern's VP Mechanical has ownership of the rolling stock plan and insuring NS meets its objectives for locomotive equipping.

9.1 Locomotives to be Equipped [§ 236.1011(a)(6)(i)]

As the number of locomotives will fluctuate with business conditions and fleet attrition between now and 2015, the NS goal is to equip 90% of its fleet. The precise number will vary, but NS expects it to remain in the range of 3,400 – 3,600 units to be equipped by December 31, 2015. This plan is based upon a snapshot of current locomotive units, which puts the total to equip at 3,411 units. *Appendix D: Locomotives to Be Equipped* provides a summary of the locomotive fleet and how many units of each model are planned to have PTC equipment installed.

Once all PTC implementations are completed, NS will have equipped the majority of its locomotive fleet. This will provide adequate PTC-equipped locomotives to protect all NS freight and work train operations, as well as local and yard switching operations on PTC equipped tracks. A percentage of locomotives will not be equipped because they are not capable of working as lead locomotives (slugs and B-units) or because they will not be used in PTC territory.

In 2009, the NS PTC pilot program celebrated attainment of its goal to equip the 40th PTC locomotive with PTC hardware. The pilot program allows the NS team to proof the hardware as it passes through stages of laboratory integration and qualification testing. This pilot has also allowed NS Mechanical, Communication and Information Technology Network team forces to assess and evaluate the optimum equipment layout and installation procedure on one of the

key locomotive models. Installation of the PTC hardware set has progressed; and as of this writing, 237 units have been installed with at least some of the hardware expected to be required in support of V-ETMS. To date, NS's Mechanical team has been the sole provider of installation services. This has grown a knowledge base within the NS organization for safe and efficient implementation of the locomotive equipping necessary for PTC.

9.2 Schedule & Progressive Implementation [§ 236.1011(a)(6)(ii)]

Full scale rollout of PTC installation on the NS fleet has started in 2010 with the planned equipping of 425 locomotives. The schedule will ramp up to add 600 locomotives in 2011; 700 units in 2012, 2013, and 2014, respectively, with the remaining 134 units completed in 2015. Additionally, NS expects to have units installed early in the process to return to shop for hardware or software upgrades during the implementation program. These are planned to be captured near the end of the program as appropriate to minimize possible rework. The table below provides further detail on the annual locomotive implementation plan.

As required by 236.1006(b)(1), NS has developed specific goals for progressive implementation of onboard systems and deployment of PTC-equipped locomotives such that the safety benefits of PTC are achieved through incremental growth in the percentage of controlling locomotives operating on PTC lines that are equipped with operative PTC onboard equipment. These goals are expressed as a percentage of trains operating on PTC lines, equipped with V-ETMS and responsive to the wayside. The goals are expressed in Table 9, column "PTC Trains." This percentage represents the number of V-ETMS trains operated in revenue service on a PTC line segment divided by the total number of trains operated in revenue service across the entire NS network. After 2015, not all trains will be PTC trains: under the PTCIP as filed, PTC will be required on 66% of NS' network; accordingly, less than 100% of NS train starts will be PTC trains running on PTC line segments. These are preliminary goals based on a number of factors which include but are not limited to:

1. Total number of train starts across the NS system
2. Number of locomotive units to be equipped annually
3. Percentage of PTC territory annually equipped with wayside devices
4. Locomotive bad order ratio, including units out of service for inspections and overhauls
5. Availability and/or assignment of locomotives to PTC line segments
6. Shared power agreements with other roads
7. Initialization success rates
8. Business traffic volumes and service demands

Given these demands on the locomotive fleet and PTC implementation requirements for 2015, NS understands the intent of these goals and asserts that V-ETMS will be deployed on PTC required lines in reasonable proportion and utilized as intended. Norfolk Southern will update these goals with any Request for Amendment if changes are necessary.

On December 31, 2015, each train operating on PTC lines is expected to run under PTC control or as specified in §236.1006(b)(1). After December 31, 2015, in the event that a train controlled by a PTC equipped locomotive fails en route or where train movement will be conducted under the exceptions described in accordance with §236.1006 (b)(4), train movement will be in accordance with §236.1029. Prior to the completion of deployment, NS will make every effort to place PTC equipped locomotives into service on line segments where PTC deployment and activation has been completed. However, locomotives not equipped with PTC or PTC equipped locomotives which fail en route will be allowed to proceed in accordance with the existing NS Operating Rules.

Table 9. NS Locomotive Equipping and Goals for PTC Trains Based on 2010 Unit Count

Year	Units to Equip	Cumulative Units Equipped	Scheduled Completion PTC-Equipped Locomotives	PTC Trains (start dependent upon FRA system certification)
2009	152	152		
2010	425	577		
2011	600	1,177	34.5%	
2012	700	1,877	55.0%	
2013	700	2,577	75.5%	15 - 33%
2014	700	3,277	96.1%	33 – 55%
2015	134 Equip 577 Upgrade	3,411	100%	55 – 90%

Norfolk Southern Railway will apply PTC to its largest fleets of locomotives first, and then to smaller groups as implementation progresses. General Electric model D9-40CW locomotives make up 32 percent of the fleet to be equipped with PTC. NS is concentrating its installation efforts on these locomotives for 2010 and 2011. The next models planned are General Electric ES40DCs and D8-40CWs. For these, NS is currently progressing PTC application engineering. NS will apply PTC to the remainder of its locomotive fleet in years 2012-2015 as equipment and resources become available.

Installation of PTC equipment on NS locomotives is planned to be performed by NS employees, assuming no operational difficulties are encountered and the projected equipping rate can be supported. The Mechanical Department plans to utilize its locomotive shops (Altoona, PA, Bellevue, OH, Conway, PA, Elkhart, IN, Enola, PA, and Roanoke, VA) for all installations and upgrades of equipment. Other smaller NS facilities may be utilized as well. Technical assistance

and guidance will be provided by service personnel from the PTC equipment suppliers or other industry technical resources as required. NS expects to share "lessons learned" among the other railroads deploying V-ETMS, where practical.

As locomotives attrite from the NS fleet, they will be removed from the PTC implementation plan and other locomotives added to maintain the overall targeted number of PTC equipped locomotives to help maintain the strategy for incremental improvements in PTC coverage. As locomotive manufacturers become capable of supplying new locomotives that are PTC equipped and enabled from the factory, NS will pursue this option for new locomotive purchases as a component of the strategy for achieving locomotive PTC implementation targets.

Norfolk Southern's Vice President Mechanical has the charge for equipping the fleet for PTC. The team reporting to the Vice President Customer Service is responsible for locomotive power assignment to the shops and then after installation, to the PTC territories. This team works in tandem to provide NS customers a well equipped and safe fleet of locomotives for service. As has been previously mentioned, the progressive equipping of the locomotives and wayside will culminate in the incremental increase in the number of PTC operated trains.

9.3 Reporting [§ 236.1011(a)(6)(iii)]

In accordance with §236.1006(b)(2), NS will report its progress toward achieving its planned PTC locomotive deployment by April 16 of years 2011, 2012, 2013, and 2014. NS' Vice President Mechanical or his designee will confer with the Manager Regulatory Compliance & Training for content of the formal report or any interim metrics.

9.4 Tenant Railroads [§ 236.1011(a)(6)(iv)(A) and (B)]

Norfolk Southern identified its tenant railroads that operate on lines that NS is required to equip with PTC in Section 5 Interoperability. Those tenants not required to file their own PTCIP who have operations on NS lines to be implemented with PTC have been notified of NS's intent to implement V-ETMS on line segments over which they operate and the expected conformance to NS's operating and safety rules. Thirty four tenants received a letter and memorandum of understanding from NS in an effort to establish an interoperability agreement; and as per the requirements of § 236.1011(a)(6)(iv), NS requested each tenant railroad provide their plans for locomotive equipping in order to comply with Subpart I. *See Appendix A-1: Tenant Railroad Responses Locomotive Equipping* for each tenant's locomotive equipping schedules as of this writing. NS will provide updates to the FRA on the progress of discussions with its tenants and periodically update this information through the RFA process as tenants provide details regarding their locomotive equipping.

10 Wayside Devices [§ 236.1011(a)(7)]

Norfolk Southern Railway's wayside installation plan shall utilize ITC-specified wayside devices to vitally monitor and report switch position, signal indications, or status of other monitored wayside devices directly to the Locomotive Segment and/or Office Segment using one or more radio networks. As described in the V-ETMS PTCDP, the Wayside Segment consists of traditional signaling equipment to which has been added a Wayside Interface Unit (WIU) function. The WIU function is responsible for interfacing the signal equipment to the Communications Segment and may be implemented as additional equipment or a software upgrade to existing equipment. Where cab signals are in use, the Wayside Segment may provide the state of the current block directly to the Locomotive Segment via cab signal codes if integrated.

The wayside installation plan presents the greatest challenge to the implementation of PTC due to the sheer volume of work involved. Not only is the workload immense, but is dispersed across over 10,904 miles of track, involves the work of various labor organizations and outside contractors, and is affected by variable risks such as weather and equipment availability. One seasoned professional has equated this effort to attempting to design, build, test and deploy a signal system in 6 years that railroaders before us have had the luxury of over 50 years to complete. To meet this enormous challenge, organizational changes are currently being put in motion, detailed plans developed, and rigorous reporting and control processes established. NS will face increased workforce demands to meet the burden placed upon it by PTC implementation, construction, support and testing.

Norfolk Southern currently has a robust and well established workflow process covering wayside signaling projects. NS will continue to follow the process already in place for designing, procuring, and releasing wayside projects to its construction forces for implementation as is illustrated at a high level in Figure 9:

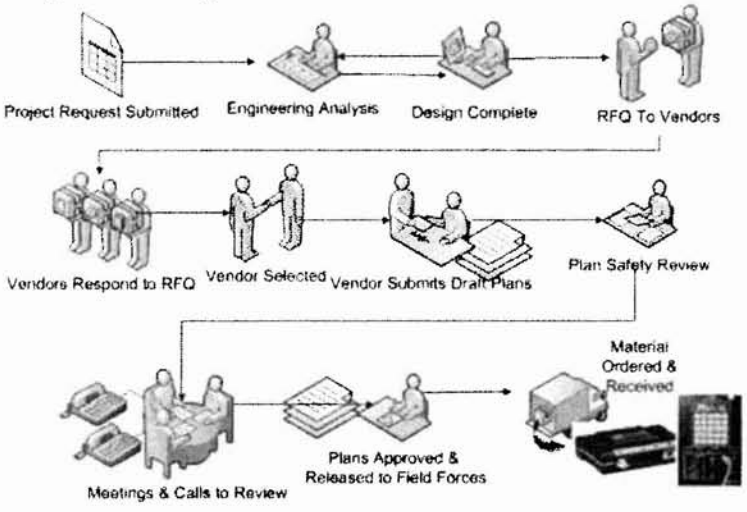


Figure 9. NS Wayside Project Request Pre-Construction Process

The number and types of wayside units NS will deploy are detailed in *Appendix E: Wayside Deployment.* This appendix provides the detail per line segment of the estimated number of wayside units required to deploy PTC at all locations identified on planned PTC line segments. Actual numbers will vary based upon the specific designs of the program and unique characteristics of individual locations. While the actual number of wayside units actually installed may fluctuate, it is not expected to impact the overall scope of effort required to install PTC at each location. NS will continue to evaluate and update the Plan as detailed design progresses to confirm this expectation, and will identify specific actions needed if issues are identified during the deployment process.

As covered in detail in Section 8, the schedule for PTC deployment on NS is based upon the risk ranking methodology. According to this Plan, PTC will be deployed in three tiers over the deployment period. Milestone goals have been established in Section 1.3.1 for completing PTC deployment to comply with the regulatory deadline of 31 December 2015. Based upon the total PTC deployment described in this Plan and provided milestones, the wayside deployment schedule is implied in the PTC deployment tier associated with each line segment. The number of wayside locations and expected wayside units per tier of NS PTC deployment is:

Tier 1 = 1,872 locations/units

Tier 2 = 1,866 locations/units

Tier 3 = 2,333 locations/units

NS will monitor wayside deployment progress against the metrics established in Section 1.3.1 to ensure Plan objectives and deployment rates are being met.

Year	*Miles of Wayside Installed*	*Total PTC Wayside Equipping*
2011	1,090 (10%)	10%
2012	2,290 (21%)	31%
2013	2,508 (23%)	54%
2014	2,508 (23%)	77%
2015	2,508 (23%)	100%

Norfolk Southern's Vice President Engineering has ownership of the wayside plan and corresponding metrics. He or his designee will confer with the Manager Regulatory Compliance & Training regarding the status of the deployment and reporting of any interim metrics or milestones.

11 Exceptions to Risk-Based Prioritization [§ 236.1011(a)(9)]

Currently there are no known exceptions to the risk based prioritization as per § 236.1011(a)(4) that cause the methodology to be impractical for application to any Norfolk Southern Railway line segment.

As time progresses and further analysis is applied to the deployment plan, there may be applicable change requests made through the RFA process.

12 Strategy for Full PTC System Deployment [§ 236.1011(b)]

At this time Norfolk Southern Railway is planning to implement PTC as required by the Railroad Safety Improvement Act of 2008 §104, Pub. L. 110-432, 122 Stat. 4848-4970, Oct. 16, 2008. (RSIA08) and 49 CFR 236, Subpart I. While Norfolk Southern will file its Technology Implementation Plan as required by Section 103 of the RSIA08, as of this filing, Norfolk Southern believes that additional line segments of PTC deployment beyond the specified scope of the RSIA08 are not warranted and do not contribute significantly to the safety of operations. The NS strategy for identifying additional line segments for PTC deployment not already specified in this Plan is to monitor and evaluate its network for safety risk to railroad employees and the public which PTC will eliminate. NS will evaluate segment characteristics annually to identify additional PTC deployment scope.

Several factors contribute to this decision and are discussed in detail below.

First, RSIA08 clearly intends to provide a means through technology to protect the communities that Norfolk Southern serves and railroad employees it employs. However, the accident statistics for the previous decade demonstrate that over 98% of the accidents reported by all railroads would not have been "PTC preventable." Norfolk Southern is focused on safety and intends to deploy PTC as required by the law. NS does not foresee safety gains that some may expect the technology to produce.

Second, rapid growth and consumer demand are already straining transportation networks across the United States. Rail transportation helps relieve congestion on the nation's highways and reduce our country's carbon footprint. Even the federal Environmental Protection Agency has noted that transportation by rail currently is the more environmentally friendly mode of transportation. Greenhouse gas emissions are directly related to fuel consumption. Because railroads are, on average, three or more times more fuel efficient than trucks, railroads have a smaller carbon footprint. Every ton-mile of freight that moves by rail instead of truck reduces greenhouse gas emissions by two-thirds or more.

Third, because NS is a "common carrier" as required under federal law, NS must accept and transport some 23,000 carloads of TIH commodities each year. While railroads are the safest way to transport TIH commodities, the "common carrier" obligations impose lopsided risk on Norfolk Southern and other railroads. In the meantime, NS has gone to great lengths to ensure the safe and secure transportation of TIH commodities. Norfolk Southern's action includes but is not limited to:

- Supporting product substitution and geographic substitution
- Supporting new design requirements to make tank cars stronger and safer
- Implementing a comprehensive security plan

- Coordinating with the Department of Homeland Security, Transportation Security Administration, Department of Transportation, Coast Guard, Customs and Border Protection, FBI, and various state Homeland Security offices
- Participating in the voluntary Customs-Trade Partnership Against Terrorism (C-TPAT) program to help ensure integrity of freight shipments
- Erecting physical barriers and new access control measures, issuing photo ID cards to employees, providing security-specific employee training, and increasing NS police patrol
- Providing information about TIH shipments to certain government agencies, and upon request to local emergency response agencies, to aid in their emergency preparedness
- Working through the Transportation Community Awareness and Emergency Response Program (TRANSCAER) to provide emergency response training, including TIH response, to organizations along the rail network

Fourth, the cost to implement PTC to meet the scope required by the Subpart is an unfunded mandate, costing the industry well over $10 billion over several years of the implementation and by the FRA's own estimates, at a cost-benefit ratio of 22-1. Norfolk Southern's cost to implement all PTC related projects now stands at $1.1 billion. As Wick Moorman, Chairman, President, and CEO of Norfolk Southern remarked during the NS 4th Quarter 2009 Earnings report, "The upshot of this ill-conceived, if well intentioned, unfunded mandate, and its associated rule making, is that we will be forced to forgo major capital expenditures for other critical areas of our property over that five-year period. And the result may well be less capacity than is required to handle traffic volumes, a diminished ability to provide good service, and even possibly a less safe working environment than we might have had otherwise."

Finally, the Subpart I regulation governing PTC as written calls for implementation on almost three quarters of Norfolk Southern's railroad. The regulation's risk methodology imposes implementation on 66% of NS's network, or 99% of its defined super-core, 93% of its core, and 86% of its strategic routes. PTC is almost certain to have a negative impact on NS's rail network velocity. Additionally, there are new requirements being placed on every component and resource of the system as the reliability of the entire system is achieved only as a sum of its parts. As more reliance is placed on the nation's railroads to efficiently move the nation's economic lifeblood, placing additional constraints to install PTC on greater portions of the NS network may well violate the intent of the legislation Congress passed in 2008 which also requires periodic analysis of the safety impact, feasibility and cost and benefits of implementing technologies to mitigate railroad safety risks.

It is on these grounds that Norfolk Southern believes that additional line segments of PTC deployment beyond the specified scope of the RSIA08 are not warranted and do not contribute significantly to the safety of operations.

13 Main Line Track Exclusion Addendum [§ 236.1019]

Norfolk Southern has no main line track exclusions to report at this time.

14 Appendices

Appendix A: Interoperability Agreements

Appendix A-1: Tenant Railroad Responses Locomotive Equipping

Appendix B: Mainline Designation

Appendix C: Installation Risk Analysis

Appendix C-1: Positive Train Control Implementation Plan (PTCIP) Risk Factor Prioritization Model

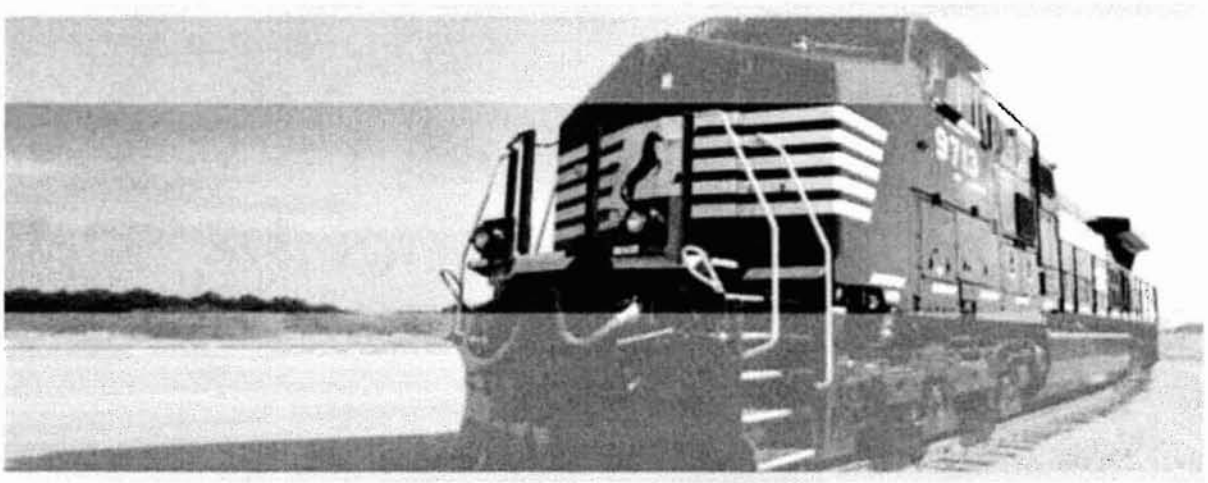
Appendix C-2: Anticipated Modifications to Traffic Characteristics

Appendix C-3: Planned Modifications to Operational Characteristics

Appendix D: Locomotives to be Equipped

Appendix E: Wayside Deployment

Norfolk Southern Railway PTC Implementation Plan (PTCIP)



Appendix A: Interoperability Agreements

MEMORANDUM OF UNDERSTANDING
IMPLEMENTATION OF POSITIVE TRAIN CONTROL

Date: **18 March 2010**

This MEMORANDUM OF UNDERSTANDING is hereby made and entered into by and between _____, hereinafter referred to as _____, and **Norfolk Southern Railway Company**, hereinafter referred to as **NSR**.

A. **PURPOSE**:

In accordance with the Rail Safety Improvement Act of 2008 (RSIA), 49 USC 20157(a)(1), NSR will be deploying Positive Train Control (PTC) on many line segments in order to comply with the RSIA, FRA 49 CFR 236 Subpart I and NSR's operating and safety rules. NSR is preparing its PTC Implementation Plan (PTCIP), required by the regulations to be submitted on or before April 16, 2010. As per §236.1011(a)(3), the PTCIP NSR submits must describe how interoperability with all tenant railroads will be achieved on line segments where PTC is deployed; it has been determined your operations on NSR include areas where PTC will be deployed. This is a MEMORANDUM OF UNDERSTANDING between NSR and _____ to obtain an interoperable PTC solution.

B. **STATEMENT OF MUTUAL BENEFIT AND INTERESTS**:

1. Both parties seek to implement PTC technical solutions which meet the requirements of Rail Safety Improvement Act of 2008 (RSIA), 49 USC 20157(a)(1), including interoperability as that term is defined in §236.1003(b).

2. NSR is planning to deploy the Wabtec V-ETMS PTC system which is designed to support interoperability. V-ETMS is a locomotive-centric, vital train control system designed to be overlaid on existing methods of operation and provide a high level of railroad safety.

3. NSR is planning on utilizing 220 MHz spectrum for PTC communication functions of radios and wayside interface units.

4. Both parties desire to participate in a PTC testing program to verify functionality and interoperability.

5. The parties will facilitate the exchange of technical information needed to implement PTC in accordance with applicable FRA requirements.

6. This Memorandum of Understanding does not modify or supersede any existing agreement between the parties.

IN WITNESS WHEREOF, the parties have executed these presents on the day and year first above writ.

Norfolk Southern Railway Company
By:
Name: Lisa C. Wilson
Title: Manager ATCS Regulatory Compliance & Training
Address: 1200 Peachtree Street, NE, Box 123
Atlanta, GA 30309

Agency/Carrier
By:_____
Name: _____
Title: _____
Address: _____
_____
_____

MEMORANDUM OF UNDERSTANDING IMPLEMENTATION OF POSITIVE TRAIN CONTROL

AMONG

BNSF RAILWAY, INC., CSX TRANSPORTATION, INC., NORFOLK SOUTHERN RAILWAY COMPANY, and UNION PACIFIC RAILROAD COMPANY, AND

Date: **March 26, 2010**

This MEMORANDUM OF UNDERSTANDING is hereby made and entered into by and between **BNSF Railway, Inc., CSX Transportation, Inc., Norfolk Southern Railway Company, and Union Pacific Railroad Company** hereinafter referred to as "**Railroads**."

A. **PURPOSE**:

In accordance with the Rail Safety Improvement Act of 2008 (RSIA), 49 USC 20157(a)(1), Railroads will be deploying Positive Train Control (PTC) on many line segments in order to comply with the RSIA, FRA 49 CFR 236 Subpart I and Railroads' operating and safety rules. Railroads are preparing their PTC Implementation Plan (PTCIP), required by the regulations to be submitted on or before April 16, 2010. In accordance with §236.1011(a)(3), the PTCIP Railroads submit must describe how interoperability will be achieved with other applicable railroads, list methods used to achieve interoperability, and identify the current state of interoperability arrangements with other railroads. By entering into this Memorandum of Understanding, Railroads acknowledge their ongoing mutual work toward meeting all of these objectives.

B. **STATEMENT OF MUTUAL BENEFIT AND INTERESTS**:

1. Railroads seek to implement PTC technical solutions which meet the requirements of Rail Safety Improvement Act of 2008 (RSIA), 49 USC 20157(a)(1), including interoperability as that term is defined in §236.1003(b).

2. Railroads have entered into a collaboration agreement to further their efforts to achieve interoperability of their various PTC systems.

3. Railroads are planning on utilizing 220 MHz spectrum for communication functions of radios and wayside interface units.

4. Railroads desire to participate in a PTC testing program to verify functionality and interoperability.

5. Railroads will facilitate the exchange of technical information needed to implement PTC in accordance with applicable FRA requirements.

6. This Memorandum of Understanding does not modify or supersede any existing agreement among Railroads.

IN WITNESS WHEREOF, the parties have executed these presents on the day and year first above writ.

BNSF Railway, Inc.

_____

Title:

CSX Transportation, Inc.

_____

Title:

Norfolk Southern Railway Company

_____

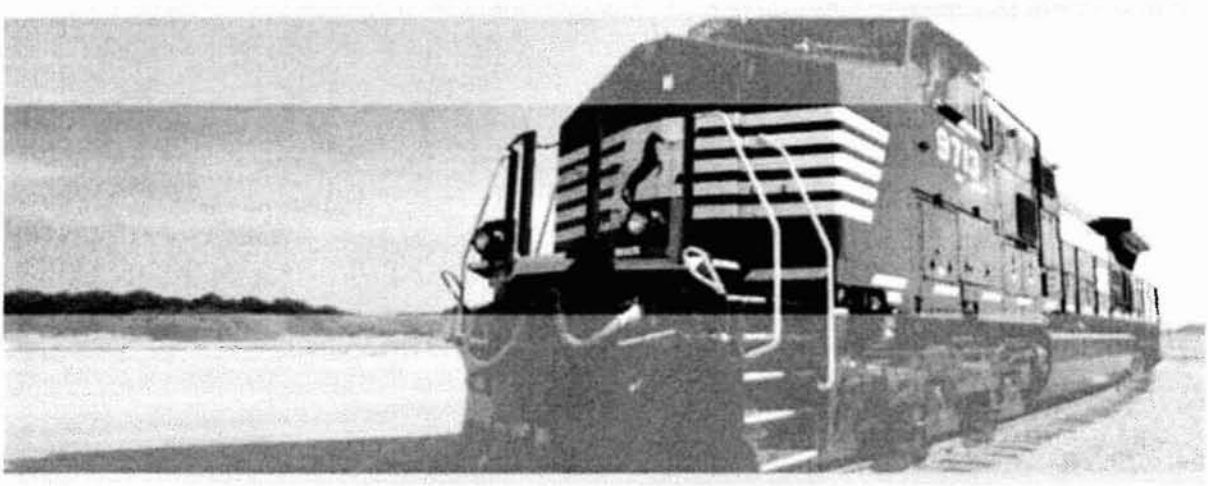
Title:

Union Pacific Railroad Company

_____

Title:

Norfolk Southern Railway PTC Implementation Plan (PTCIP)



Appendix A-1: Tenant Railroad Responses
Locomotive Equipping

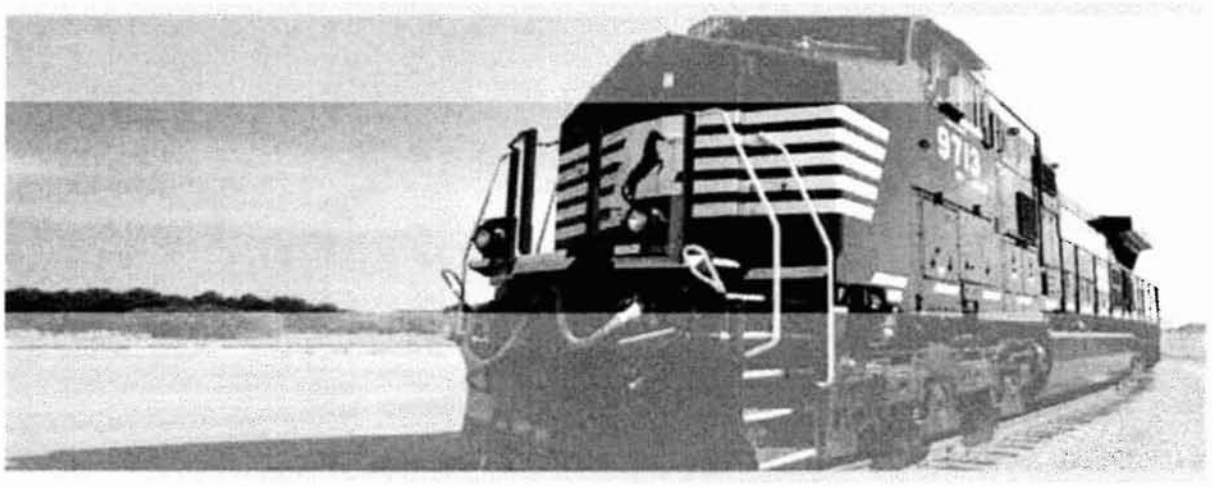
Norfolk Southern Railway PTCIP

Appendix A-1 Tenant Railroad Responses Locomotive Equipping

July 9, 2010 v 1.3

Tenant Railroad Name	Locomotives To Be Equipped	Schedule For Equipping	Response to Written Request as of July 1
Alabama & Gulf Coast Railway, LLC	Unknown	Unknown	No response
Allegheny Valley Railroad	TBD	TBD	Executed Agreement
Buffalo & Pittsburgh RR	Unknown	Unknown	Want to revise MOU
Camp Chase Industrial Railroad	TBD	TBD	Executed Agreement
Chattooga & Chickamauga Railway Co.	Unknown	Unknown	Want to revise MOU
Chicago, Fort Wayne & Eastern Railroad	Unknown	Unknown	Don't have to install PTC.
Columbus & Ohio River Railroad	Unknown	Unknown	No response
Commonwealth Railway Inc.	Unknown	Unknown	Want to revise MOU
Dubois County Railroad	Unknown	Unknown	No response
GA Southern Railroad c/o Pioneer Rail	TBD	TBD	Executed Agreement
Georgia & Florida Railroad	Unknown	Unknown	No response
Georgia Southwestern Railroad Company, Inc.	Unknown	Unknown	No response
Grand Elk Railroad	Unknown	Unknown	No MOU
Indiana & Ohio Railway	Unknown	Unknown	No MOU
Indiana Harbor Belt Railroad Company	Unknown	Unknown	Only offers to run restricting on ML
Indiana Northeastern Railroad Co.	TBD	TBD	Executed Agreement
L&N RR c/o Regional Rail LLC	Unknown	Unknown	No response
Lycoming Valley Railroad	5 units TBD	Prior to 12/31/2015	Executed Agreement
New York Susquehanna & Western RY	9 (EMD SD40-2)	TBD	Executed Agreement
North Carolina Department of Transportation	TBD	TBD	Executed Agreement
North Shore Railroad Company	5 units TBD	Prior to 12/31/2015	Executed Agreement
Ohio Central System	Unknown	Unknown	Want to revise MOU
Ozark Valley Railroad Inc.	Unknown	Unknown	Don't have to install PTC.
Paducah and Louisville RR	Unknown	Unknown	Rework interchange agreement
Reading, Blue Mountain & Northern RR	Unknown	Unknown	Don't have to install PTC.
RJ Corman RR Company	Unknown	Unknown	Rework interchange agreement for one location, install PTC for another, no MOU
Rochester & Southern Railroad	Unknown	Unknown	No response
Sandersville Railroad Company	TBD	TBD	Executed Agreement
Tennessee Valley Railroad Museum	Unknown	Unknown	No response
Terminal Railroad Association of St Louis	17 (SD 40/45 & GP-38)	SD40/45: 20% in 2013, 40% in 2014, 40% in 2015 GP38: 20% in 2013, 40% in 2014, 40% in 2015	Executed Agreement
The Kansas City Southern Railway Company	11	TBD	Executed Agreement
Wabash Central, LLC	Unknown	Unknown	No response
Western New York & Pennsylvania Railroad, LLC	Unknown	Unknown	Don't have to install PTC.
Wheeling and Lake Erie RR	TBD	TBD	Executed Agreement
Youngstown and Southeastern Railroad	Unknown	Unknown	No response

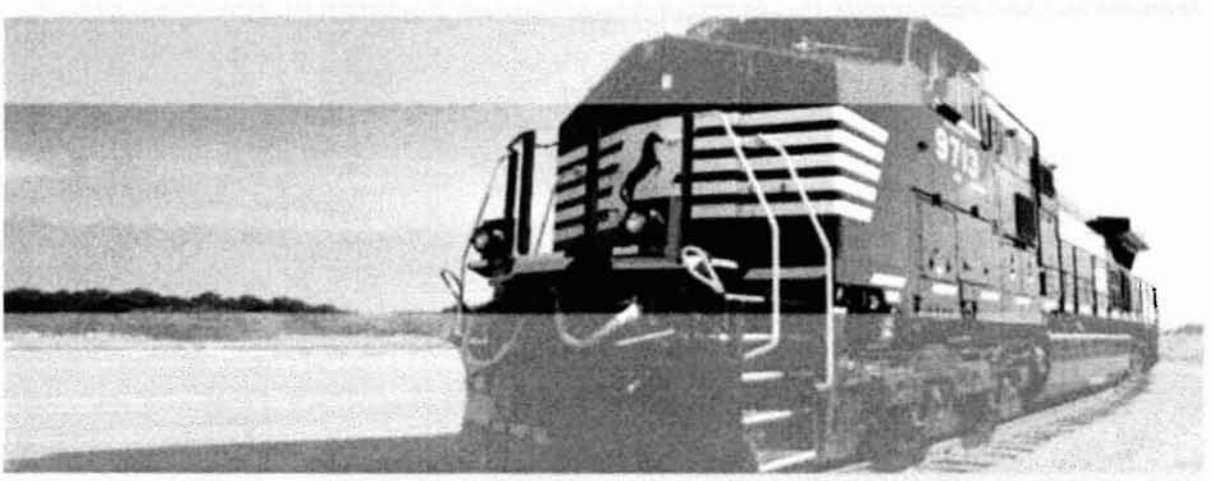
Norfolk Southern Railway PTC Implementation Plan (PTCIP)



Appendix B: Mainline Designation

The content of this section has been redacted.

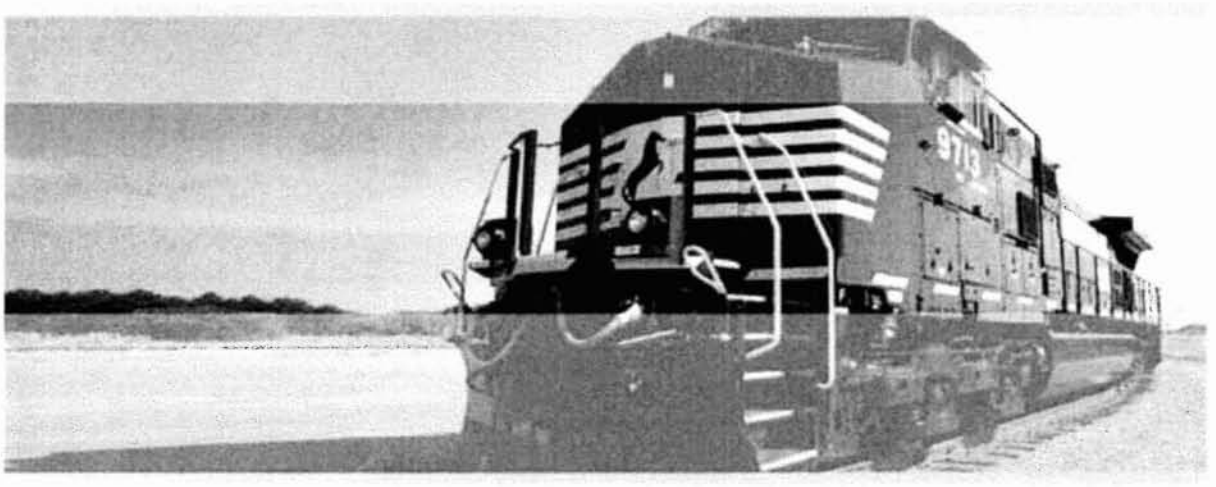
Norfolk Southern Railway PTC Implementation Plan (PTCIP)



Appendix C: Installation Risk Analysis

The content of this section has been redacted.

Norfolk Southern Railway PTC Implementation Plan (PTCIP)



Appendix C-1: Risk Factor Prioritization Model

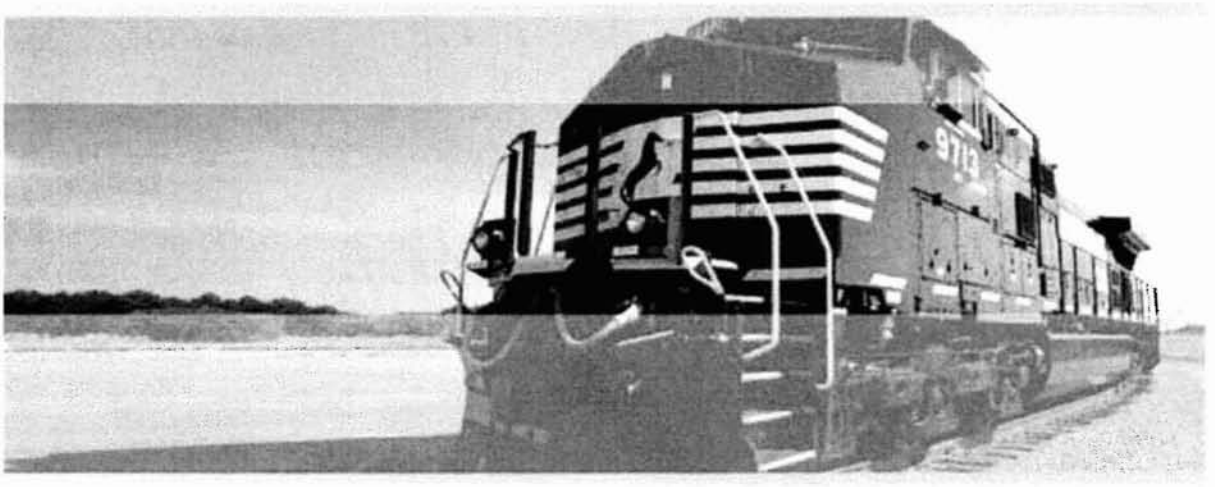
The content of this section has been redacted.

Norfolk Southern Railway PTC Implementation Plan (PTCIP)

Appendix C-2: Anticipated Modifications to Traffic Characteristics

The content of this section has been redacted.

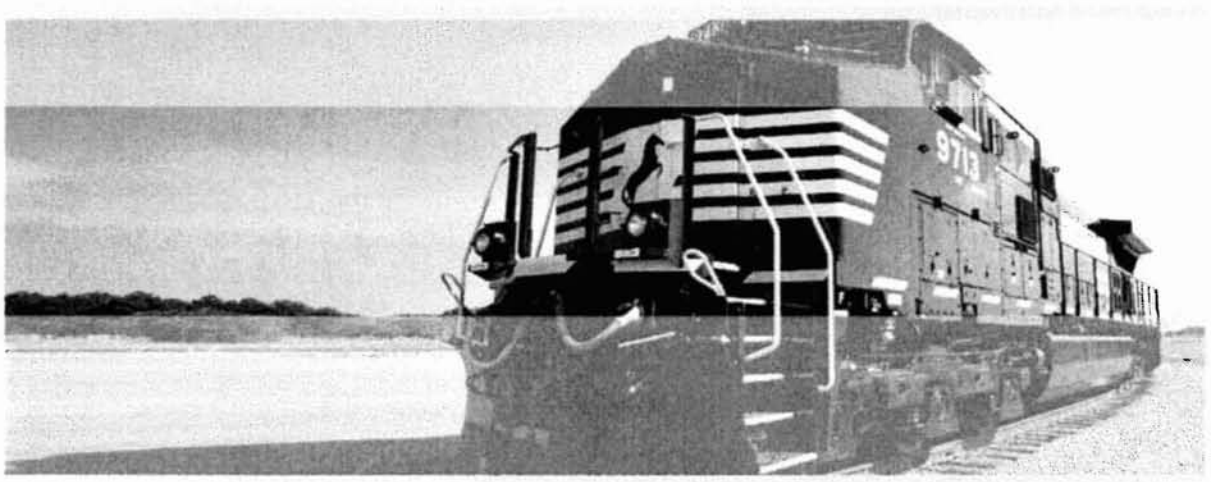
Norfolk Southern Railway PTC Implementation Plan (PTCIP)



Appendix C-3: Planned Modifications to Operational Characteristics

The content of this section has been redacted.

Norfolk Southern Railway PTC Implementation Plan (PTCIP)

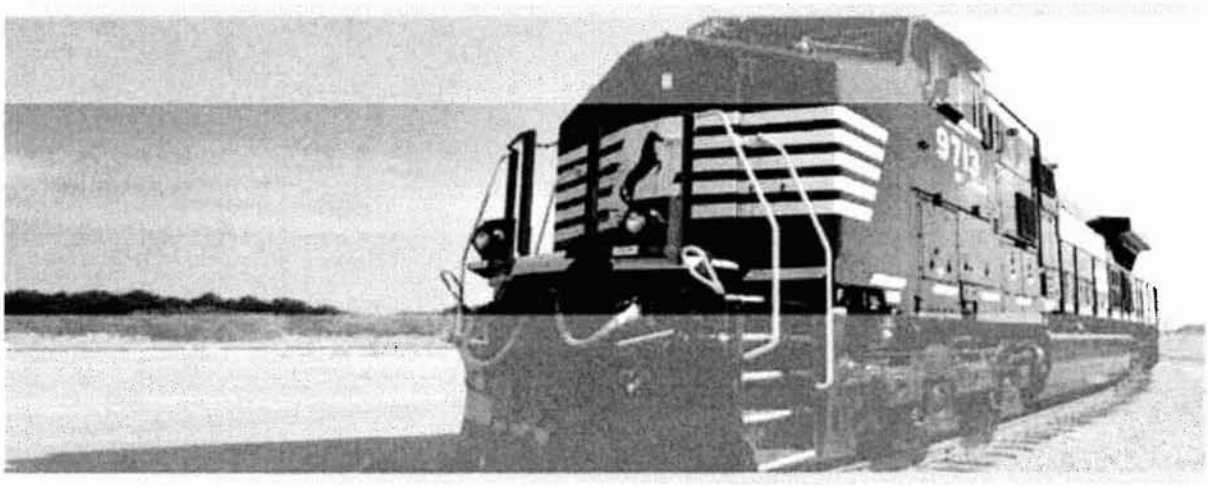


Appendix D: Locomotives to Be Equipped

Norfolk Southern Railway PTCIP
Appendix D Locomotives To Be Equipped
July 9, 2010 v 1.3

Locomotive Model	Horsepower	Quantity in Fleet	Equip With PTC	PTC Equip Units
3GS-21B	2100	2	YES	2
3GS21CDB	2100	1	NO	0
BP4	1350	1	NO	0
D8-32B	3200	45	YES	45
D8-40C	4000	88	YES	88
D8-40CW	4000	154	YES	154
D9-40C	4000	125	YES	125
D9-40CW	4000	1089	YES	1089
ES40DC	4000	220	YES	220
ES44AC	4400	24	YES	24
F7B	1500	2	NO	0
F9A	1750	2	YES	2
GP38AC	2000	2	NO	0
GP38-2	2000	502	YES	502
GP38-3	2000	37	YES	37
GP40-2	3000	103	YES	103
GP50	3500	50	NO	0
GP59	3000	34	YES	34
GP60	3800	48	YES	48
MP15DC	1500	87	NO	0
PR43C	4000	2	YES	2
RCP4	0	2	NO	0
RP14DBD	1400	2	NO	0
RP20BD	2100	2	YES	2
RP20CD	2100	1	NO	0
RP-E4	0	2	NO	0
RP-E4C	0	14	YES	14
RP-E4D	0	26	NO	0
RP-E4U	0	15	NO	0
RPU6	0	38	NO	0
SD38	2000	17	NO	0
SD38-2	2000	1	NO	0
SD40-2	3000	385	YES, Some	344
SD40-E	3000	22	YES	22
SD45-2	3000	6	YES	6
SD50	3500	23	NO	0
SD60	3800	163	YES	163
SD60I	3800	46	YES	46
SD60M	3800	44	YES	44
SD70	4000	80	YES	80
SD70M	4000	68	YES	68
SD70M-2	4000	130	YES	130
SD80MAC	5000	17	YES	17
SD9M	0	2	NO	0
SW1001	1000	8	NO	0
SW1500	1500	24	NO	0
	Grand Totals	**3,756**		**3,411**

Norfolk Southern Railway PTC Implementation Plan (PTCIP)



Appendix E: Wayside Deployment

The content of this section has been redacted.