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To Whom It May Concern:

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Respectfully Submitted,

C D Carroll

Director, Operations
Positive Train Control
Canadian Pacific

CANADIAN PACIFIC

Canadian Pacific Railway Company

Positive Train Control Implementation Plan

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1. Introduction

1.1 Overview

This Positive Train Control Implementation Plan (PTCIP), which has been generated by Canadian Pacific Railway Company (CP) to meet the requirements of 49 U.S.C. § 20157 [1] and 49 CFR Part 236, Subpart I, § 236.1011 [2], describes CP's approach for implementing a positive train control (PTC) vital overlay system on all portions of CP's US network for which PTC deployment is required by 49 CFR § 236.1005(b), as further outlined in Section 1.4 of this document. This plan, which has been submitted in advance of the April 16, 2010 deadline required by 49 CFR § 236.1009(a)(1), will allow for a PTC system certified under 49 CFR § 236.1015 and meeting the requirements of 49 CFR § 236.1005 to be installed on the required portions of track prior to the December 31, 2015 deadline required by 49 CFR § 236.1005(b).

In order to deploy a system that meets both the statutory and regulatory requirements for PTC in advance of the statutory deadlines, CP generated this PTCIP which addresses a number of key aspects of PTC implementation, including the following:

- ***Functional Requirements*:** The accompanying Notice of Product Intent (NPI) [3], discussed in Section 3 of this PTCIP, satisfies the content requirements of an NPI, as identified in 49 CFR § 236.1013. The NPI includes a description of the functional requirements that the proposed PTC system must meet and describes how the PTC technologies to be deployed will safely meet these functional requirements when applied to CP's operations.
- ***Compliance with Regulatory Requirements:*** A description of how CP intends to fully comply with the procedural requirements identified in CFR § 236.1009, which requires that the railroad apply for and receive PTC System Certification from the FRA prior to deploying a PTC system for use in revenue service, is included. Identified risks that could create increased difficulty in the successful completion and delivery of a PTC system meeting the statutory requirements are also described.
- ***Interoperability:*** A description of how the PTC system will provide for interoperability between CP and its tenant railroads on the track to be equipped with PTC technologies is included. This includes agreements between CP and tenant railroads, discussion of the technologies to be utilized, and identified potential risks or obstacles to interoperability.
- ***Risk-Based Deployment of PTC:*** This PTCIP includes a risk analysis, the results of which will dictate the priority with which PTC will be deployed across the subdivisions of CP's network for which implementation of PTC is required. To the extent practical, CP will implement PTC to address areas of greater risk to the public and railroad employees before areas of lesser risk.

- ***Deployment Sequence and Schedule:*** This PTCIP identifies the types and numbers of wayside locations and rolling stock to be equipped, and it provides schedules for completing the required activities, as well as providing an overall consolidated schedule which outlines the commissioning of subdivisions for revenue service of the PTC system.
- ***Strategy for Full PTC System Deployment:*** CP's strategy for full system-wide deployment of PTC systems on portions of track beyond those required to be equipped by 49 CFR Part 236, Subpart I is summarized.

The organization and contents of this PTCIP are heavily based on the organization and content requirements identified in the *PTCIP Template* [4] issued by FRA. The *PTCIP Template* provides guidance on the format and contents of the PTCIP, but with a limited degree of specificity, which thereby allowed CP to tailor the plan to best reflect the specifics of its own operations. In addition to addressing the key aspects of PTC implementation described above, CP's PTCIP addresses other content guidelines included in FRA's *PTCIP Template*, as appropriate.

Before addressing the details of the various PTC implementation aspects summarized above, this *Introduction* section provides an overview of CP's PTC program. A summary of the contents of the remaining subsections are summarized below.

- ***Section 1.1.1*** outlines the program organization and describes the roles and responsibilities of the key entities, both internal and external to CP, required to ensure successful implementation of PTC.
- ***Section 1.1.2*** describes how CP will make and file a Request for Amendment (RFA) of this PTCIP in accordance with 49 CFR § 236.1021.
- ***Section 1.2*** describes the overall goals and objectives of CP's PTC program.
- ***Section 1.3*** describes how CP will measure success for both the long-term and intermediate goals of PTC implementation.
- ***Section 1.4*** describes CP's US network and identifies the portions of track where PTC will be deployed.
- ***Section 1.5*** describes the organization of the remaining sections of this PTCIP document.

1.1.1 Organizational Relationships

The establishment of a structured organization with clearly-defined roles and responsibilities will be critical to the successful implementation of PTC. The hierarchical structure of the organization that has been established to conduct the primary activities related to planning, execution, and controlling CP's PTC program is shown in Figure 1-1 below. The roles and responsibilities of the various entities identified in Figure 1-1 are summarized in Table 1-1 below.

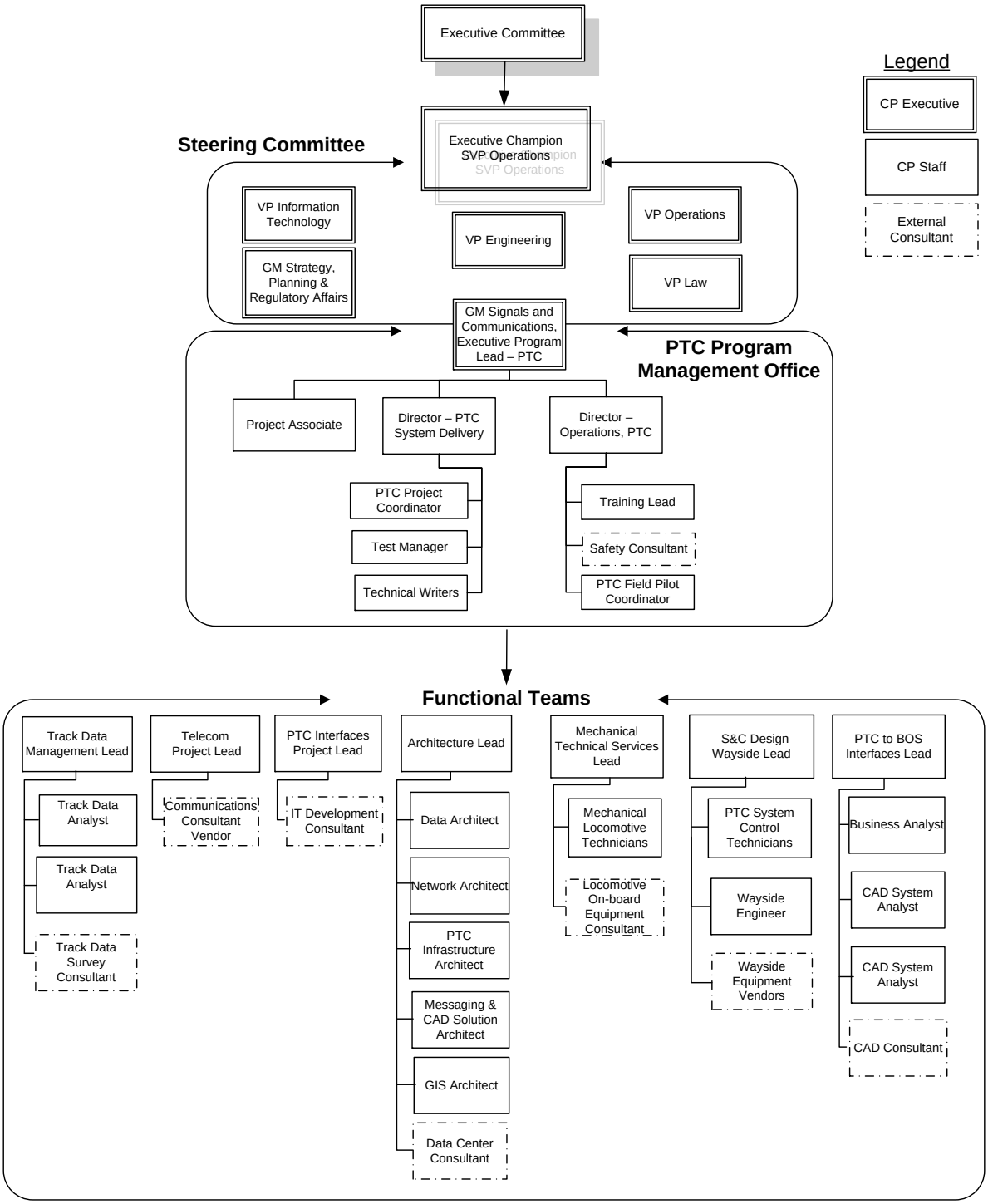

Figure 1-1: Canadian Pacific PTC Program Organizational Chart

Table 1-1: Canadian Pacific PTC Program Roles and Responsibilities

Roles	Responsibilities
Executive Committee	• Responsible for establishing and managing Canadian Pacific overall corporate strategy • Must approve any capital expenditures greater than $10 million
Executive Champion SVP Operations	• Overall champion of this initiative • Overall accountability to meet the business objectives • Spokesperson for the project at the Executive Committee
Steering Committee	• Guidance on strategic direction for PTC • Decisions on funding allocation and priorities that have already been approved by Executive Committee • Makes decisions on scope, schedule and budget changes
GM Signals and Communications (S&C), Executive Program Lead – PTC	• Chair of the steering committee • Establishes business objectives and project justification • Accountable for project budget and realization of objectives, industry and regulatory representation • Communicates project progress and directions to members of the steering committee and executive steering committee • Raises project issues and risks inherent to the project, to other related projects, or affected areas of business operations
PTC Program Management Office	• Consists of the Executive Program Lead -PTC, Director-Operations PTC and Director – PTC System Delivery, and supporting resources shown in Figure 1-1, such as the Test Manager and PTC Field Pilot Coordinator • Defines and supports execution of all program administrative processes and ensures alignment and compliance with CP policies, procedures and processes • Specifically responsible for overall systems engineering and integration
Director –Operations, PTC	• Oversees all Business Operations aspects of this project • Ensures that all project deliverables will comply with Business Operations requirements • Leads all activities for which the Operational Functional Teams are responsible • Working with Safety Consultant, leading the effort to pull together all regulatory documents that need to be submitted to provide CP authority to implement their PTC system solution • Specifically responsible for the PTCIP, PTCDP and PTCSP plans
Director – PTC System Delivery	• Oversees the system delivery aspects of the project • Sets direction on the project management and solution development methodologies to be followed for all project streams • Establishes, monitors, and tracks performance of the overall PTC Program Management Plan and program budget
Project Associate	• Supports the PTC Program Management office in the execution of administration tasks
PTC Project Coordinator	• Prepares overall Program Status report and assists PMO office in the development of Steering Committee presentations • Develops and implements project administrative procedures • Where required, manages the delivery of a specific scope of work or deliverable
Training Lead	• Responsible for identifying, developing and managing the delivery of all required training necessary for CP staff to utilize and maintain the PTC system
Safety Consultant	• Provides expertise in the field of Railway Industry safety engineering methodologies and standards that will help shape CP's PTCIP, PTCDP and PTCSP plans • Oversees quality assurance process

Table 1-1: Canadian Pacific PTC Program Roles and Responsibilities (Continued)

Roles	Responsibilities
PTC Field Pilot Coordinator	• With support from vendors, is responsible for the successful planning, execution, and completion of all field work associated with the Field Pilot testing and Prescribed Safety Runs • Liaise with Field Operations, Mechanical Services, Engineering and Network Management Center (NMC) departments at a Service Area Level to ensure timely and appropriate equipment deployment, appropriate work train service and required track time are provided
Test Manager	• Responsible for coordinating and implementing process, product and service quality assurance within the organization or throughout a project life-cycle • Working with the appropriate resources, develops test plans, test logistics, test scripts and test scenarios, and works with project lead to ensure appropriate resources are assigned and coordinated with the assistance of the project manager to execute • Ensures testing is acceptable to SOX and Internal Audit, as well as other key stakeholders and functional groups • Logs and works with the team to resolve any issues or defects that may become apparent during testing • Tracks and reports on test progress and status
Technical Writers	• Supports all PTC project members in the development of key design, process, testing and training documentation
Project Leads (Functional Teams)	• For their area of expertise, develop project plans (activities, schedules, milestones, resources, risks, etc) to complete the deliverables and forwards to PTC Project Coordinator to consolidate in overall project plan • Manage suppliers, subcontractors, and related contract delivery clauses within their scope of work • Ensure that the project work results are compliant with the stated requirements, priorities, and strategies of the project
PTC to BOS Interfaces Lead	• Ensures that PTC BOS solution complies with the PTC rules as well as aligns with the train control system requirements • Plans, organizes, and negotiates agreements with Train Control Business System team to supply required resources to support this project • Monitors, evaluates and reports on the progress of the Train Control Business System team work assignments
Business Analyst	• Collaborates with and supports the CAD team • Define requirements and confirm stated requirements with application users, when needed • Review project deliverables related to the domain of expertise
CAD System Analysts	• Support the business analyst in defining the interface requirements by providing subject matter expertise on CP's CAD system
CAD Consultant	• Provide support in developing the interfaces required between the BOS and PTC systems
Signals and Communications (S&C) Design Wayside Lead	• Responsible for the successful planning, execution, and completion of work associated with developing design and implementation plans for the wayside infrastructure
PTC System Control Technicians	• Dedicated field resources that will install or assist 3rd party vendors in installing base repeater equipment and wayside devices • Execute a number of the test scripts within the lab and the Ottumwa Field Pilot • Working with the Wayside Engineer, develop implementation procedures that will be used for the PTC Production Field Implementation • Develop procedures for installing wayside equipment, base repeater equipment, etc.

Table 1-1: Canadian Pacific PTC Program Roles and Responsibilities (Continued)

Roles	Responsibilities
Wayside Engineer	• Devises strategies for enabling wayside devices to interface to PTC systems • Works with ITC to develop wayside devices PTC interface requirements • Develops engineering drawings, with assistance from Wayside Equipment Vendor, for wayside devices to be used for Ottumwa pilot • Develops standard wayside construction drawing package, with assistance from Wayside Equipment Vendor, to be used for the PTC Production Field Implementation project
Wayside Equipment Vendors	Wayside Equipment Vendors will be responsible for: • Providing project management for their scope • Factory unit testing • System testing • Leading the user acceptance testing • Training of CP Staff • Support of Wayside Engineer in development of wayside construction drawing package
Mechanical Technical Services Lead	• Devises strategies for implementing and integrating PTC onboard systems onto CP's locomotive fleet, including specific details on how to integrate PTC onboard computers with existing locomotive systems • Develops engineering drawings, with assistance from vendors, depicting how to install test PTC systems on test locomotives to be used for Ottumwa pilot • Develops standard PTC locomotive systems construction drawing packages including interfaces to energy management systems, assisted by vendors, to be used for the PTC Production Field Implementation project
Mechanical Locomotive Technicians	• Develops installation procedures for PTC onboard computers • Retrofits CP's locomotives with PTC onboard computers
Locomotive On-board Equipment Consultant	The vendor that supplies the Locomotive Onboard Computer system will be responsible for: • Providing project management for their scope • Developing an Onboard Computer System Requirements Specification document • Factory unit testing • System testing • Leading the user acceptance testing • Designs to integrate Onboard Computer system with GE's and GM's locomotive controls • Training of CP Staff
Architecture Lead	• Leads the assessment, design, and development of the overall project solution architecture based on business requirements and IT strategies

Table 1-1: Canadian Pacific PTC Program Roles and Responsibilities (Continued)

Roles	Responsibilities
Architects	**Data Architect** • Develops logical and physical data models in accordance with current standards and guidelines • Ensures physical data structures support the requirements of the solution **Network Architect** • Assists the ITC in developing communications systems specifications and messaging protocol specifications • Develops conceptual and detailed architecture drawings for the communications systems (radio networks, WAN backhaul networks and back office LANs) **PTC Infrastructure Architect** • Assists the ITC committee in developing PTC security system specifications and back office system specifications • Documents the non-functional requirements for PTC and BOS applications • Develops disaster recovery strategy for PTC and BOS applications • Develops conceptual and detailed architectural drawings for the data center infrastructure that support PTC and BOS applications • Develops conceptual and detailed architecture for security systems and communications systems (radio networks, WAN backhaul networks and back office LAN networks) • Works with Data Center Consultant to produce detailed construction blueprints for the data center infrastructure and security systems **Messaging and CAD Solution Architect** • Develops conceptual and detailed architecture for all PTC and BOS system interfaces to existing CP information systems **GIS Architect** • Identifies tools and technologies to be used for the collection and maintenance of spatial data • Develops long-term design of GIS environment
Data Center Consultant	• Develop the data center infrastructure architecture and the associated operating models to support this infrastructure • Depending on the final operating model that CP chooses, could eventually be responsible for acquiring the data center hardware, implementing it and working with CP and other vendors to commission the PTC and dispatching systems
PTC Interfaces Project Lead	• Manages all project activities associated with interfacing the PTC BOS to existing IT systems, such as crew management and train consist applications
IT Development Consultant	• Develops code required to interface the IT systems to the PTC and BOS applications
Telecom Project Lead	• With support from the Communications Consultant Vendor, responsible for the successful planning, execution, and completion of work associated with developing design and implementation plans for the PTC communications system
Communications Consultant Vendor	• Supports Network Architect in the development of the PTC WAN and field network

Table 1-1: Canadian Pacific PTC Program Roles and Responsibilities (Continued)

Roles	Responsibilities
Track Data Management Lead	• Responsible for the successful planning, execution, and completion of work associated with developing design and implementation plans for the PTC track data service • Develops new Common Track Network (CTN) data service which will provide track data for PTC • Works with the owners of the track data to develop process to maintain • Works with service consumers and customers to elicit, analyze, communicate, validate, document and manage track data service requirements • Gathers service operator business requirements • Develops functional and non-functional requirements • Determines service outputs, service units and unit cost-of-service • Determines key service metrics • Determines service cost-identification / recovery • Determines service level requirements from providers • Prioritizes requirements • Identifies desired changes to service outputs, performance, supported volumes, pricing • Establishes supply plan for consumers
Track Data Analysts	• Validate GIS data • Build and populate data stores using data obtained using the Fli-map process
Track Data Survey Consultant	• Conducts the LiDAR Track Surveys

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

Documentation related to CP's PTC program, including all safety-related and FRA-required documentation, shall be the responsibility of the CP Program Management Office (PMO), with overall responsibility for this documentation and the filing with FRA resting with the position of Director, Operations – PTC.

Each workstream lead in CP's PTC organization shall be responsible for identifying the need for amendments to portions of the PTCIP document applicable to their workstream. In addition, a yearly review of annual MGT and PIH traffic volumes will be performed by the PMO senior team to determine if any changes will result in a revision to where PTC shall be implemented. The PMO senior team is comprised of the Executive Program Lead – PTC, the Director – PTC System Delivery, and the Director – Operations, PTC.

All CP PTC program team members will be directed to report any changes that may warrant an amendment to the PTCIP to their functional team lead, who will submit any proposed modifications or amendments to the PMO senior team for review and approval. If the PMO senior team agrees that the proposed modification or amendment is necessary and sufficiently material to warrant an RFA, per the requirements of CFR 49 § 236.1021(h), the Director, Operations – PTC shall first informally confer with FRA regarding the proposed changes.

Once such informal consultation is complete, and if deemed appropriate, CP shall proceed with the formal submission of an RFA by providing the Associate Administrator with an electronic version (read-only format) of the RFA via email (or as otherwise directed by the Associate Administrator). Such submission shall contain the necessary information as required and recommended in CFR 49 § 236.1021(d). No changes shall be made to the PTCIP until FRA approval has been received for the RFA. Once approval has been received, the plan shall be amended, and the approved changes shall be adopted by CP.

CP will maintain an in-house configuration management (CM) system that effectively documents and controls all PTC safety and FRA-required documentation, using *Information Technology Infrastructure Library (ITIL) Version 3.0 – Service Asset and Configuration Management (SACM)* as a guide, and tailored for CP's PTC program. All records will be given unique revision and version numbers and will be appropriately and clearly dated. A history of revisions and versions will be maintained for documents as necessary. All files will be maintained in at least two locations to ensure retention of all documents and supporting information.

1.2 Goals and Objectives

The primary goal for the deployment of PTC technologies on CP's US 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. Enhancements to system safety will be achieved as a PTC vital overlay system is progressively deployed across all portions of the CP US network for which PTC deployment is required by 49 CFR § 236.1005(b), with all required portions of the CP US network to be fully equipped, operational, and interoperable with all tenant railroads by December 31, 2015. Goals and objectives relating to various aspects of PTC deployment are described in additional detail below.

***Quality and Safety*:** 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. 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, CP will ensure that all vendors from whom PTC technologies are to be acquired will have an acceptable quality assurance program for both design and manufacturing processes. The "systems" approach that will be employed by CP will also help 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 will be necessary, as it is anticipated that products from multiple vendors will be integrated into the PTC system design.

System Coverage: In complying with the requirements of 49 CFR § 236.1005, CP will be equipping 28 of its 48 US subdivisions and spur tracks with PTC technologies, corresponding with approximately 69% of CP's 3,975 total US network route miles, excluding yard limits. Of the roughly 2,736 route miles to be equipped, approximately 556 route miles accommodated passenger operations in 2008 and virtually all route miles accommodated some TIH/PIH traffic in excess of 56,000 loads and residue empties in 2008[1]. The benefits achieved through the implementation of PTC on tracks where passenger traffic and TIH/PIH traffic are present will provide added protection to railroad crew members, railroad equipment, and the general public by preventing accidents involving all types of traffic (including other non-TIH/PIH hazardous freight and non-hazardous freight); not just passenger traffic and TIH/PIH traffic. This is aligned with Congress' goal of reducing the number and rates of accidents, incidents, injuries, and fatalities involving railroads, as identified in Section 102 of RSIA08.

Progressive Risk-Based Deployment: The progressive deployment of PTC technologies across CP's subdivisions will take place in a manner such that, to the extent practical, the PTC system will be implemented to address areas of greater risk to the public and railroad employees before areas of lesser risk. CP will also achieve 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 equipped controlling locomotives operating on PTC lines.

Interoperability: The PTC system will provide for interoperability between CP and all tenant railroads, as technical, semantic, and organizational interoperability will be achieved to enhance the ability of CP and its tenants to operate together safely. Interoperability between CP and its tenants will be achieved through product testing, industry partnership, common technology, and standard implementation. CP and its tenants will work closely together throughout the PTC deployment process to ensure that all aspects of interoperability are fully addressed, and this partnership will be on-going as the railroads proceed to operate on these equipped portions of the CP network into the foreseeable future. CP has chosen, as a matter of policy, to ensure that all movements made, by host or tenant, on any subdivision where PTC has been deployed will be PTC equipped by December 31, 2015.

Regulatory Compliance: In order to meet the December 31, 2015 deadline mandated by Congress, CP has developed this PTCIP in accordance with 49 CFR § 236.1011 and the accompanying NPI in accordance with 49 CFR § 236.1013(e), both of which are being submitted to FRA for approval prior to the required April 16, 2010 deadline. It is CP's intent to achieve FRA PTC System Certification by second quarter[2], 2012 and to deploy PTC on all required

[1]The total loads and residue empties represent an aggregate of all line segment numbers in Table 1-2, Table 1-3, and Table 1-4. As shipments cross multiple subdivisions, this number is not an accurate reflection of the total TIH/PIH shipments. The total TIH/PIH loads and residue empties handled in 2008 on CP was in excess of 17,000.

[2]All references to annual quarters in this document are on the traditional calendar basis (as opposed to fiscal calendar or other).

portions of the network by August 15, 2015, such that CP's PTC system will be fully operational by December 31, 2015.

1.3 Success Criteria

This section describes the long-term and intermediate goals related to PTC system certification and implementation. CP's progress towards the achievement of these goals will be tracked by CP's PTC PMO, who will be responsible for reporting the status of these goals to CP's Steering Committee on a quarterly basis. CP will annually report to FRA its progress toward achieving its goals, including any adjustments required to remedy shortfalls.

1.3.1 System Certification Success Criteria

Key success criteria that must be met in order to achieve PTC system certification are identified below:

- Prior to the production phase of wayside construction, CP intends to install wayside equipment for the purposes of testing and evaluation on the Ottumwa Subdivision in Iowa. This work is scheduled to commence during the construction season of 2010, and be completed by March 2011. This work, coupled with the equipping of some twenty locomotives with on-board PTC equipment as outlined in Section 8, will allow CP to conduct end-to-end field testing of the various components to be employed in the production system, and to provide validation in support of the safety case for the PTC system to be deployed on the balance of CP's PTC equipped network. This test and evaluation period is scheduled from January 2011 to the end of the second quarter in 2012. All testing will be performed in accordance with 49 CFR § 236.1035.
- It is CP's intent to achieve FRA PTC System Certification by second quarter, 2012 and to deploy PTC on all required portions of the network by August 15, 2015, such that CP's PTC system will be fully operational by December 31, 2015.
- As put forth in 49 CFR § 236.1015, the host railroad is required to submit a PTC Safety Plan (PTCSP) in order to get its subsequent PTC System Certificate. CP expects to submit the PTCSP per the following schedule:
    - Draft PTCSP to be submitted by October, 2011
    - PTCSP to be formally submitted to FRA by December 1, 2011
    - Prescribed runs started by December 1, 2011
    - System certification received by June, 2012.

1.3.2 PTC Implementation Success Criteria

The subsections following contain goals related to wayside PTC deployment, locomotive PTC equipment installation, and the progressive effective use of equipped locomotives on PTC lines that have been made operational.

1.3.2.1 Wayside PTC Deployment

A subdivision will be considered complete when it has been commissioned for revenue service as described in Section 7 of this PTCIP. CP has established the following goals for the number of subdivisions it shall have commissioned for revenue PTC operation on an annualized basis:

- **Year end 2012:** Pilot subdivision commissioned, production construction commenced
- **Year end 2013:** 11 of 28 subdivisions have been completed or 39%
- **Year end 2014:** 24 of 28 subdivisions have been completed or 86%
- **Year end 2015:** 28 of 28 subdivisions have been completed or 100%.

1.3.2.2 Locomotive Installation

In order to deliver to the progressive risk-based deployment of PTC and the interim goals for percentage of equipped trains operating on PTC subdivisions, as summarized in Section 1.3.2.3 below, CP has established the following goals for the number of locomotives that it shall have equipped with PTC onboard equipment responsive to the wayside:

- **Year end 2012:** 176 of 563 locomotives have been equipped or 31%
- **Year end 2013:** 332 of 563 locomotives have been equipped or 59%
- **Year end 2014:** 488 of 563 locomotives have been equipped or 87%
- **Year end 2015:** 563 of 563 locomotives have been equipped or 100%.

1.3.2.3 Equipped Trains Operating

This section includes success criteria for progressively effective use of equipped locomotives on PTC lines that have been made operational. Given the different progressive rates of field construction, commissioning and equipping of locomotives, the values expressed below represent the expected rate achieved at year end for trains operating on PTC-equipped lines that are equipped with operative onboard PTC apparatus responsive to the wayside:

- **Year end 2013:** 33% of trains operating on commissioned PTC subdivisions
- **Year end 2014:** 60% of trains operating on commissioned PTC subdivisions
- **Year end 2015:** 100% of trains operating on commissioned PTC subdivisions.

1.4 Applicability

This section provides an overview of CP's US rail network and identifies those portions of the network for which PTC deployment is required by 49 CFR § 236.1005(b). CP's US rail network, which is shown in Figure 1-2, consists of three primary areas of operation, which include: 1) the Northeast US Service Area 2) the Chicago and St. Paul Service Areas, and 3) the Dakota, Minnesota, & Eastern Railroad (DM&E). The subsections following briefly describe each of these three areas of operation.

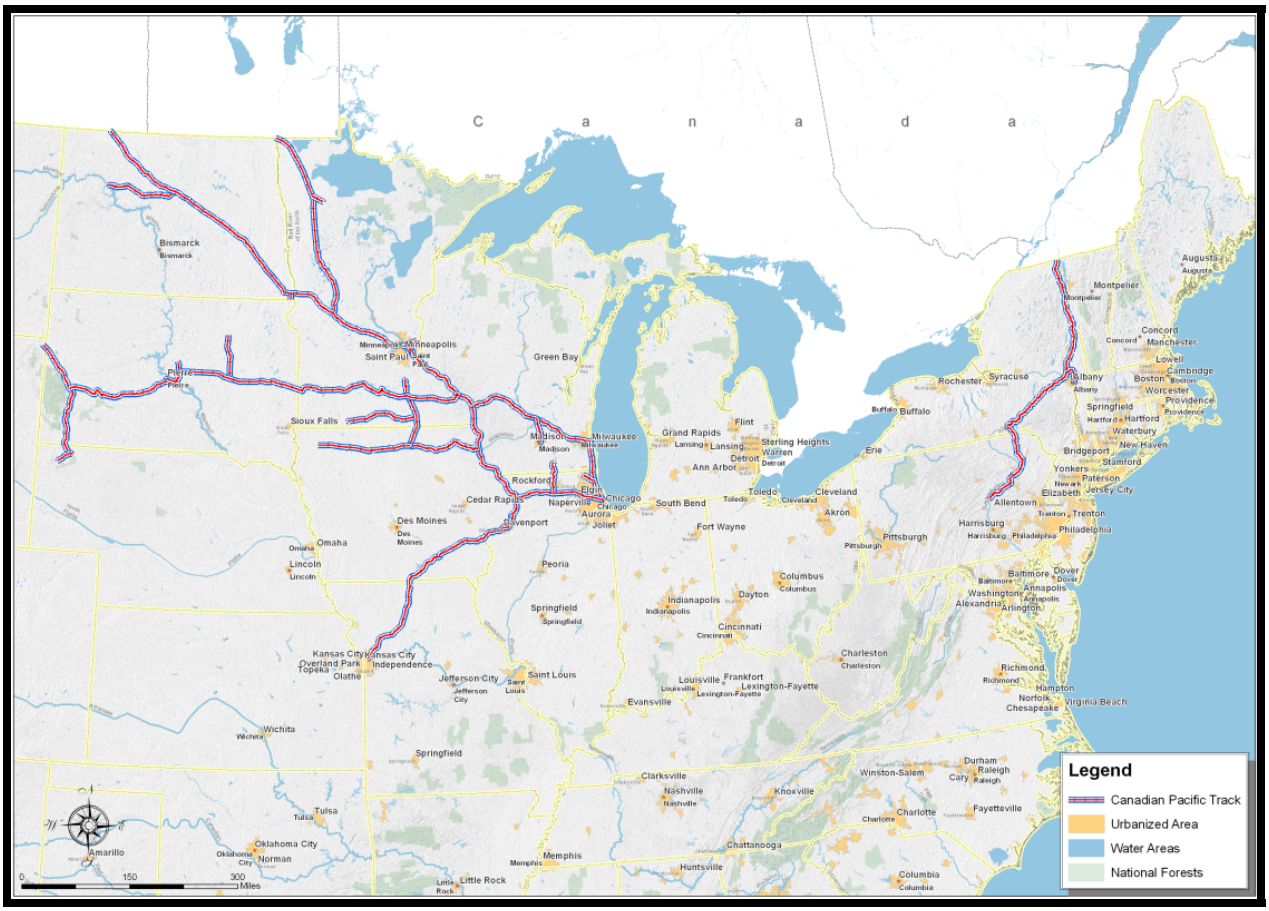

Figure 1-2: Map of Canadian Pacific US Rail Network

1.4.1 Northeast US Service Area

As shown in Figure 1-3 below, the northern extremity of the Northeast US Service Area is at the Canadian border along the northeastern corner of the state of New York. From this point, track runs along the eastern border of New York into northeastern Pennsylvania.

The Northeast US Service Area is composed of the five subdivisions identified in Table 1-2 below, which together include approximately 474 route miles of track for which CP is considered the host railroad. For each subdivision, Table 1-2 includes 1) the maximum gross tonnage that traveled on any segment of the subdivision in 2008, 2) the number of cars traveling on the subdivision carrying poison- or toxic-by-inhalation (PIH or TIH) loads or residue in 2008, 3) the average number of passenger trains per day which traveled on any portion of the subdivision in 2008, 4) the subdivision milepost range, 5) the milepost ranges of main line track, per the definition of main line provided in 49 CFR § 236.1003, 6) the milepost ranges of track not meeting the definition of main line per 49 CFR § 236.1003, 7) and the milepost ranges of track that CP will be equipping with PTC. Additional details of the Northeast US Service Area and all

other CP track that is to be equipped with PTC are provided in the GIS shape files included in Appendix D of this PTCIP.

Provided in parentheses in the column that identifies non-main-line track is an indication of why an identified segment of track is not defined as main line. The presence of the letters "YL" indicate that a track segment is within yard limits in TWC territory (where trains are limited to restricted speed), while the letters "MGT" in this column indicate that the segment of track does not meet the 5 million gross ton (MGT) threshold identified in 49 CFR § 236.1003 (no instances of "MGT" can be found in Table 1-2, but instances can be found in Table 1-3 and Table 1-4, which are discussed in the subsections following).

Of the 474 route miles of track in the Northeast US Service Area, approximately 466 route miles are considered main line, as defined in 49 CFR § 236.1003. These portions of track are considered main line by virtue of having over 5 MGTs of railroad traffic transported over this track in the year 2008. In addition to meeting the minimum MGT threshold, the Canadian and Freight subdivisions also meet the definition of main line since they are used for regularly scheduled intercity service. The Amtrak Adirondack and the Amtrak Ethan Allen Express both run twice daily over portions of these two subdivisions. All of the 466 miles of main line track in the Northeast US Service Area will be equipped with PTC, as TIH/PIH materials were transported over these segments of track in 2008.

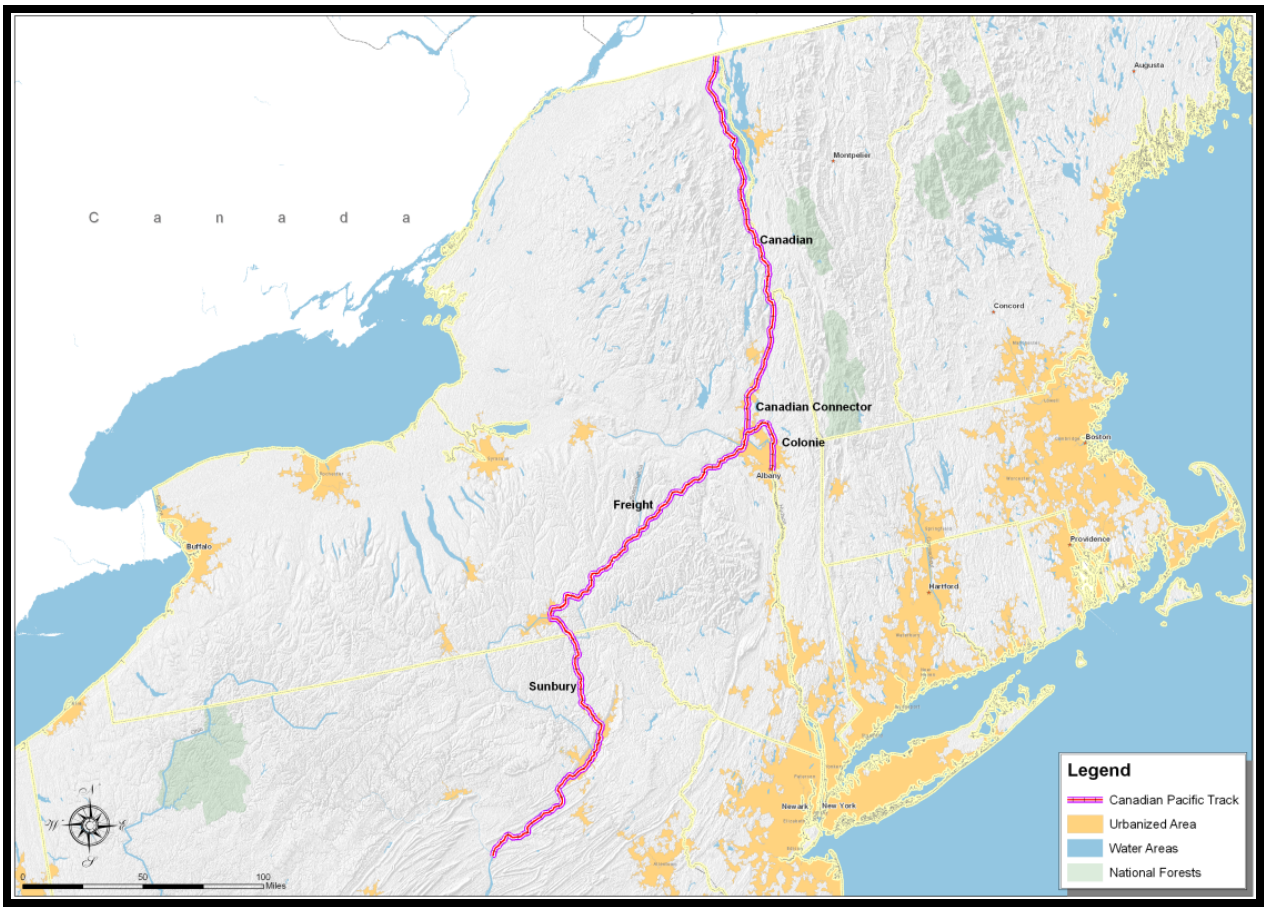

Figure 1-3: Map of Canadian Pacific Northeast US Service Area

Table 1-2: Subdivisions of the Canadian Pacific Northeast US Service Area

Subdivision	2008 Gross Tonnage	2008 TIH/PIH Traffic (Cars/Year)	2008 Passenger Traffic (Trains/Day)	Subdivision Milepost Range	Main-Line Track	Non-Main-Line Track	Track to Be PTC-Equipped
Canadian	This material redacted		4	21.7 – 190.6	21.7 – 190.6	None	21.7 – 190.6
Canadian Connector			0	23.2 – 24.3	23.2 – 24.3	None	23.2 – 24.3
Colonie			0	0.2 – 19.1	0.2 – 19.1	None	0.2 – 19.1
Freight			4	467.4 – 616.0	467.4 – 612.8	612.8 – 616.0 (YL)	467.4 – 612.8
Sunbury			0	616.0 – 752.0	620.2 – 752.0	616.0 – 620.2 (YL)	620.2 – 752.0

1.4.2 Chicago and St. Paul Service Areas

As shown in Figure 1-4 below, the Chicago and St. Paul Service Areas (also known colloquially as the SOO Line), run from Chicago, Illinois, northwest through Minneapolis, Minnesota, to Glenwood, Minnesota, where two separate lines of track continue to meet the Canadian border at locations in Portal, North Dakota and Noyes, Minnesota. The Chicago and St. Paul Service Areas are composed of the 19 subdivisions and 2 spur tracks identified in Table 1-3 below, which together include approximately 1431 route miles of track for which CP is considered the host railroad.

Of the 1431 route miles of track in the Chicago and St. Paul Service Areas for which CP is the host railroad, approximately 1199 miles are considered main line, as defined in 49 CFR § 236.1003. All of the approximately 1199 miles of main line track in the Chicago and St. Paul Service Areas will be equipped with PTC, as all of these main line segments of track accommodated some quantity of TIH/PIH materials and/or regularly scheduled intercity passenger service in 2008, thereby meeting one or more of the criteria for PTC identified in 49 CFR § 236.1005(b).

As shown in Table 1-3, 13 of the 19 subdivisions and 2 spur tracks contain track that qualifies as main line as a result of accommodating over 5 MGTs of traffic during the year 2008. The Merriam Park subdivision only experienced approximately 2.5 MGTs of traffic in 2008, but track in this subdivision is considered main line due to the fact that it was used for regularly scheduled intercity passenger service. In addition to meeting the definition of main line by meeting the minimum 5 MGT threshold, the River, Tomah, Watertown, C&M, Fox Lake and Elgin subdivisions also meet the definition of main line as a result of being used for regularly scheduled intercity or commuter rail passenger service. The Amtrak Empire Builder runs twice daily over portions of the River, Tomah, Watertown, C&M, and Merriam Park subdivisions and the Amtrak Hiawatha runs 14 trains daily on the C&M subdivision. The Elgin and Fox Lake subdivisions, which are owned by Metra, and therefore not included in the subdivision counts, each accommodate regularly scheduled commuter service at nearly 50 trains per day.

Various segments of track in the Chicago and St. Paul Service Areas, while dispatched by CP, are owned and effectively controlled by other railroads, such that these other railroads are considered the host per 49 CFR § 236.1003. As previously mentioned, the Elgin and Fox Lake subdivisions are owned by Metra and will, therefore, be equipped by Metra. A stretch of the C&M subdivision, between mileposts 0.0 and 32.3, is also owned by Metra. BNSF and CP jointly own the segment of the River Subdivision between mileposts 392.1 and 407.4, as well as the segment of the Merriam Park Subdivision where multiple tracks are present between mileposts 407.4 and 408.9. CP has reviewed the PTCIP of Metra and has filed a letter associating itself with this plan. For the sections of track jointly owned with BNSF, CP has committed to installing the requisite PTC equipment in cooperation with BNSF.

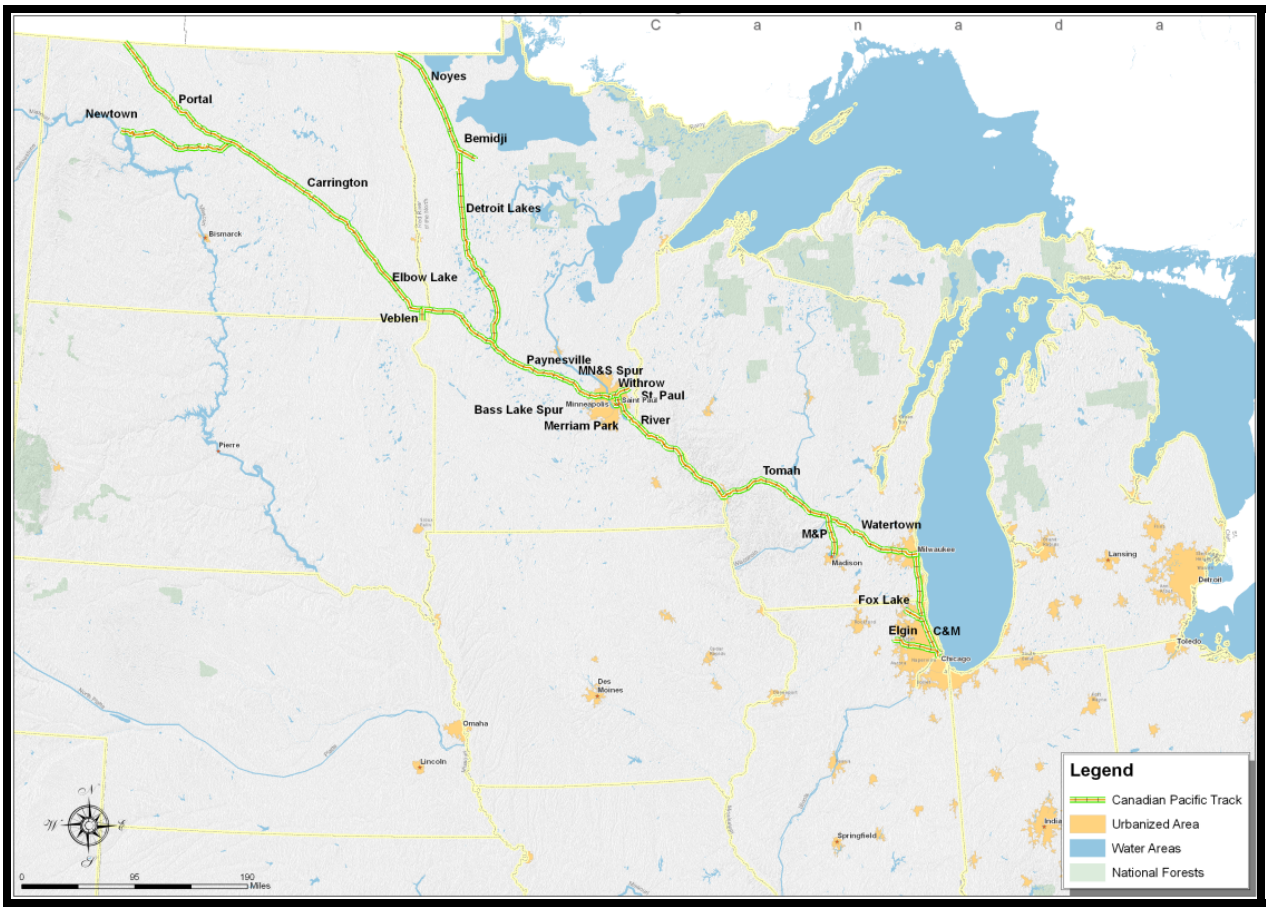

Figure 1-4: Map of Canadian Pacific Chicago and St. Paul Service Areas

Table 1-3: Subdivisions of the Canadian Pacific Chicago and St. Paul Service Areas

Subdivision	2008 Gross Tonnage	2008 TIH/PIH Traffic (Cars/Year)	2008 Passenger Traffic (Trains/Day)	Subdivision Milepost Range	Main-Line Track	Non-Main-Line Track	Track to Be PTC-Equipped
Portal	This material redacted			396.5 – 550.2	399.0 – 547.5	396.5 – 399.0 (YL) 547.5 – 550.2 (YL)	399.0 – 547.5
Carrington				257.3 – 396.5	259.0 – 394.5	257.3 – 259.0 (YL) 394.5 – 396.5 (YL)	259.0 – 394.5
Elbow Lake				120.3 – 257.3	122.0 – 255.0	120.3 – 122.0 (YL) 255.0 – 257.3 (YL)	122.0 – 255.0
Noyes				307.4 – 386.5	310.0 – 383.5	307.4 – 310.0 (YL) 383.5 – 386.5 (YL)	310.0 – 383.5
Detroit Lakes				120.3 – 307.4	122.6 – 305.5	120.3 – 122.6 (YL) 305.5 – 307.4 (YL)	122.6 – 305.5
Newtown				418.5 – 529.4	None	418.5 – 529.4 (MGT)	None
Veblen				194.5 – 210.0	None	194.5 – 210.0 (MGT)	None
Bemidji				411.5 – 433.8	None	411.5 – 433.8 (MGT)	None
St. Paul				11.8 – 17.1	None	11.8 – 17.1 (MGT)	None
Paynesville				1.0 – 120.3	1.0 – 120.3	None	1.0 – 120.3
Withrow				0.0 – 20.7	0.0 – 20.7	None	0.0 – 20.7
MN&S Spur				7.2 – 25.7	None	7.2 – 25.7 (MGT)	None
Merriam Park#				407.4 – 416.2	407.4 – 416.2	None	407.4 – 416.2
Bass Lake Spur*				428.3 – 435.1	None	428.3 – 435.1 (MGT)	None
River##				288.0 – 407.4	288.0 – 407.4	None	288.0 – 407.4
Tomah				178.2 – 288.0	178.2 – 288.0	None	178.2 – 288.0
Watertown				87.3 – 178.2	87.3 – 178.2	None	87.3 – 178.2
M&P				0.0 – 30.2	None	0.0 – 30.2 (MGT)	None
C&M**				32.3 – 87.3	32.3 – 87.3	None	32.3 – 87.3
Fox Lake	This material redacted		*Fox Lake and Elgin subdivisions under Metra ownership. Metra is host railroad.*				
Elgin							

#Portion of subdivision between MP 407.4 and MP 408.9 under joint ownership with BNSF. BNSF is controlling/dispatching road.
##Portion of subdivision between MP 392.1 and MP 407.4 under joint ownership with BNSF. BNSF is controlling/dispatching road.
*Frequency of operation and level of traffic so infrequent as to be below standard measurable gross tonnage thresholds.
**Portion of subdivision between MP 0.0 and MP 32.3 under Metra ownership. Metra is host railroad. Data included in table only reflects track owned by CP.

1.4.3 Dakota, Minnesota & Eastern Railroad (DM&E)

As shown in Figure 1-5 below, the Dakota, Minnesota & Eastern Railroad (DM&E) provides service in eight states, including Illinois, Wisconsin, Missouri, Iowa, Minnesota, South Dakota, Nebraska, and Wyoming. The DM&E, which is a wholly owned subsidiary of CP, has been officially controlled by CP since October of 2008, but it presently remains a separate, independently-operated entity, which reported individually as a Class Two Railroad in 2009. The DM&E is composed of the 22 subdivisions and 2 spur tracks identified in Table 1-4 below, which together include approximately 2072 route miles of track for which CP is considered the host railroad.

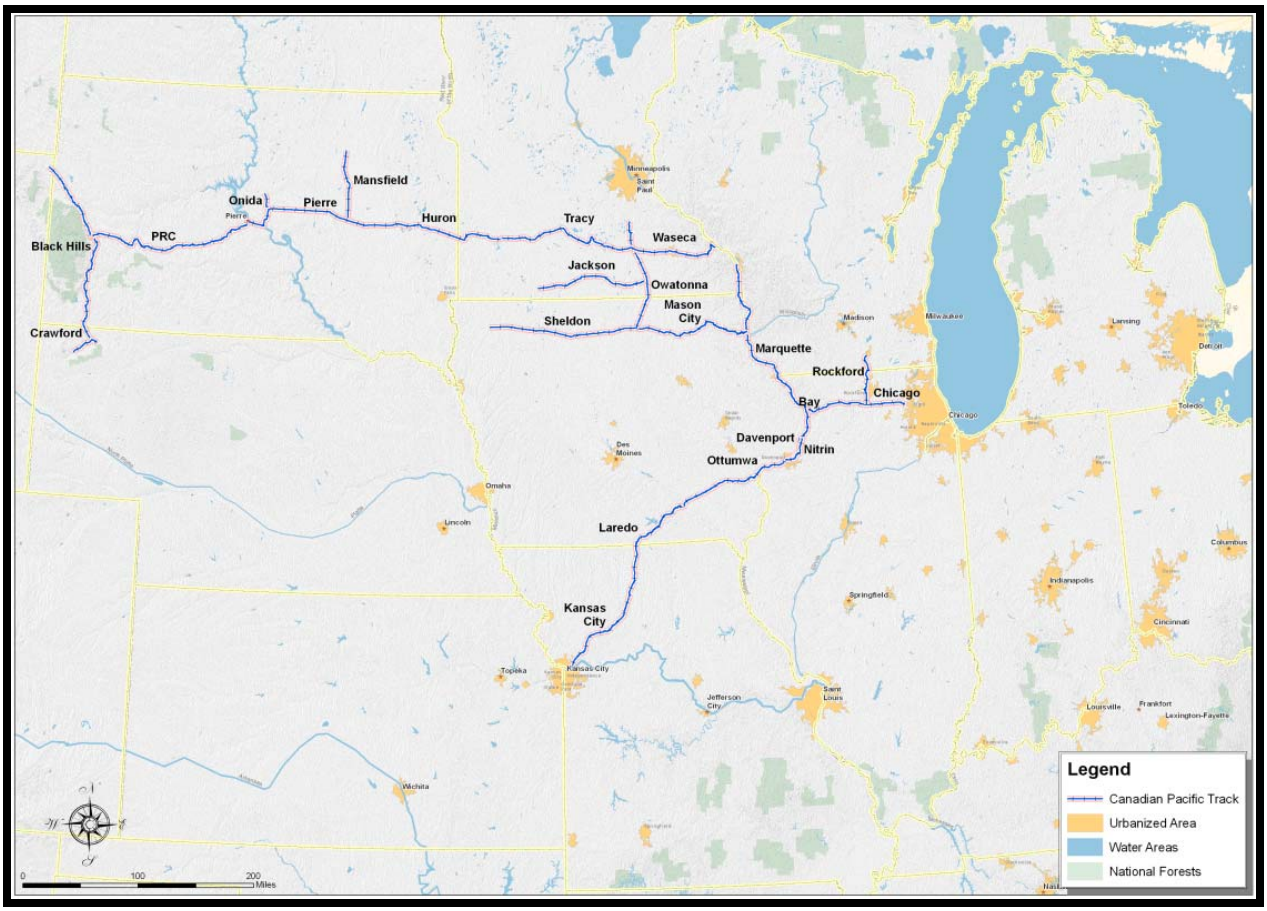

Figure 1-5: Map of DM&E Railroad

Of the 2072 route miles of track that make up the DM&E, approximately 1160 miles on 12 subdivisions are considered main line, as defined in 49 CFR §236.1003. All track that is classified as main line meets the definition of main line by virtue of a minimum of 5 MGTs of traffic having traveled over the subdivision in the year 2008. No passenger service exists on the DM&E.

In 2008, PIH/TIH traffic was present on 11 of the 12 subdivisions that contain main line track, with the Owatonna subdivision being the only one of the 12 subdivisions that did not accommodate TIH/PIH traffic in 2008. As a result, all main line track on the 11 subdivisions that did accommodate TIH/PIH traffic will be equipped with PTC, subject to the de minimis considerations discussed below, while no portions of the Owatonna subdivision will be equipped. This accounts for a total of 1073 miles of track that will be equipped with PTC.

Of the 11 DM&E subdivisions for which PTC deployment is currently planned, CP has identified three subdivisions for which requests for relief may later be submitted to FRA per the de minimis provisions included in 49 CFR § 236.1005(b)(4)(ii)(C). 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, CP only intends to note that the DM&E Tracy, Huron, and Pierre subdivisions will be further assessed to determine whether they may qualify for exemption under these de minimis provisions. CP will continue to investigate the types of mitigations that would be required to ensure that risk of a release of PIH materials would be negligible on these subdivisions, and CP will also attempt to gain a better understanding of how best to demonstrate to the FRA that this risk is negligible. This version of CP's PTCIP, however, includes plans for deploying PTC on these three subdivisions since PTC deployment will be required on these subdivisions until CP has provided the FRA with sufficient evidence to indicate that the risk of PIH release is negligible.

It should be noted that CP has included the necessary information regarding the DM&E property in this filing, in response to the FRA's change in position received July 2nd, 2010 which required CP to include DM&E in its Implementation Plan. CP had been working on the planning for DM&E since making its original submission and was able to complete the work required within the revised time, but minor inaccuracies may remain in the associated GIS files found in Appendix D. CP will resolve any data anomalies that may be detected subsequent to this filing.

Table 1-4: Subdivisions of the Dakota, Minnesota & Eastern Railroad

Subdivision	2008 Gross Tonnage	2008 TIH/PIH Traffic (Cars/Year)	2008 Passenger Traffic (Trains/Day)	Subdivision Milepost Range	Main-Line Track	Non-Main-Line Track	Track to Be PTC-Equipped
Black Hills	This material redacted			0.4 – 174.7	None	0.4 – 174.7 (MGT)	None
PRC				484.4 – 649.2	None	484.4 – 649.2 (MGT)	None
Pierre				362.7 – 484.4	366.3 – 484.4	362.7 – 366.3 (YL)	366.3 – 484.4
Onida				98 – 115.1	None	98 – 115.1 (MGT)	None
Mansfield*				66.9 – 376.3	None	66.9 – 376.3 (MGT)	None
Huron				226.6 – 362.7	228.0 – 360.8	226.6 – 228.0 (YL) 360.8 – 362.7 (YL)	228.0 – 360.8
Yale Spur				91.1 – 160.3	None	91.1 – 160.3 (MGT)	None
Tracy**				102.5 – 226.6	107.25 – 129.6 142.4 – 224.8	102.5 – 107.25 (YL) 129.6 – 142.4 (YL) 224.8 – 226.6 (YL)	107.25 – 129.6 142.4 – 224.8
Waseca***				0.2 – 102.5	None	0.2 – 102.5 (MGT)	None
Hartland Spur				87.5 – 107.0	None	87.5 – 107.0 (MGT)	None
Owatonna				0.0 – 123.8	1.0 – 42.0 74.0 – 123.8	0.0 -1.0 (YL) 42.0 – 74.0 (YL) (2.5 actual track miles)	None

* BNSF is controlling/dispatching road for a 32.2 mile portion of Mansfield subdivision between MP 39.7 and Wolsey.
**UP is controlling/dispatching road for portion of Tracy subdivision between MP 129.6 and MP 142.4.
***UP is controlling/dispatching road for portion of Waseca subdivision between MP 0.2 and MP 1.7.

Table 1-4: Subdivisions of the Dakota, Minnesota & Eastern Railroad (Continued)

Subdivision	2008 Gross Tonnage	2008 TIH/PIH Traffic (Cars/Year)	2008 Passenger Traffic (Trains/Day)	Subdivision Milepost Range	Main-Line Track	Non-Main-Line Track	Track to Be PTC-Equipped
Jackson#	This material redacted			43.0 – 149.4	None	43.0 – 149.4 (MGT)	None
Mason City				0.0 – 116.7	1.5 – 113.5	0.0 – 1.5 (YL) 113.5 – 116.7 (YL)	1.5 – 113.5
Sheldon				116.7 – 253.4	None	116.7 – 253.4 (MGT)	None
Marquette##				0.0 – 159.0	0.0 – 95.6 100.0 – 159.0	95.6 – 100.0 (YL)	0.0 – 95.6 100.0 – 159.0
Bay###				140.9 – 141.2	140.9 – 141.2	None	140.9 – 141.2
Chicago				40.3 – 141.5	40.3 – 141.5	None	40.3 – 141.5
Rockford^				0.0 – 45.8	None	0.0 – 45.8 (MGT)	None
Davenport				141.5 – 195.7	141.5 – 193.0	193.0 – 195.7(YL)	141.5 – 193.0
Eldridge				0.0 – 9.7	None	0.0 – 9.7 (MGT)	None
Nitrin^^				0.0 – 20.3	None	0.0 – 20.3 (MGT)	None
Ottumwa				195.7 – 302.8	198.6 – 302.8	195.7 – 198.6 (YL)	198.6 – 302.8
Laredo				302.8 – 405.1	304.6 – 405.1	302.8 – 304.6 (YL)	304.6 – 405.1
Kansas City^^^				405.1 – 498.8	405.1 – 498.8	None	405.1 – 498.8

#UP is controlling/dispatching road for portion of Jackson subdivision between MP 122.8 and MP 130.2.
##CN is controlling/dispatching road for portion of Marquette subdivision between MP 41.7 and MP 43.6.
###Bay subdivision, connecting track between Marquette and Chicago Subs, was established in 2009 (no data for 2008). Marquette gross tonnage and TIH/PIH data were used as proxy.
^Illinois Railway is controlling/dispatching road for portion of Rockford subdivision between MP 0.0 and MP 12.9, and WSOR is controlling/dispatching road for portion of Rockford subdivision between MP 45.3 and MP 45.8.
^^ BNSF is controlling/dispatching road for portion of Nitrin subdivision between MP 0.0 and MP 1.7.
^^^UP owns No. 1 track on Kansas City subdivision between UP mileposts 460.4 and 483.6 and is the host railroad on this segment.

1.5 Document Overview

This section provides an overview of the organization of this PTCIP.

- This section, Section 1, describes the general objectives, applicability, and scope of this PTCIP.
- Section 2 provides a list of documents that are referenced in this PTCIP.
- Section 3 addresses the functional requirements that the PTC system must meet, as required by 49 CFR § 236.1011(a)(1).
- Section 4 describes how CP intends to comply with 49 CFR § 236.1009, as required by 49 CFR § 236.1011(a)(2).
- Section 5 describes how CP will provide for interoperability between itself (the host) and all tenant railroads, as required by 49 CFR § 236.1011(a)(3).
- Section 6 determines 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 49 CFR § 236.1011(a)(4).
- Section 7 defines the sequence, schedule, and decision basis for the line segments to be equipped, as required by 49 CFR § 236.1011(a)(5).
- Section 8 identifies the rolling stock that will be equipped with PTC technology, as required by 49 CFR § 236.1011(a)(6), and it defines a schedule for equipping rolling stock.
- Section 9 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 49 CFR § 236.1011(a)(7).
- Section 10, by referencing Section 1.4, addresses which track segments CP designates as main-line and non-main-line track, as required by 49 CFR § 236.1011(a)(8).
- Section 11 identifies and describes where CP has made exceptions to the risk-based prioritization in Section 6 above, as required by 49 CFR § 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, including the criteria that will be applied in identifying those additional lines.
- Section 13 addresses Main Line Track Exclusion Addendums (MTEAs), as defined by 49 CFR § 236.1019.
- Appendices A, B, C, D, and E provide supporting details that aid in the understanding of various portions of this PTCIP. The appendices include A) a summary of a review of previous studies applicable to the risk prioritization model, B) a detailed construction schedule, C) correspondence with tenant railroads, D) shape files detailing portions of CP's US network that will be equipped with PTC, and E) a risk prioritization model spreadsheet.

1.6 Acronyms and Definitions

Table 1-5 below provides a listing of acronyms that are used in this document, along with their meanings.

Table 1-5: Acronyms Used in Canadian Pacific's Positive Train Control Implementation Plan

Acronym	Meaning
AAR	Association of American Railroads
BNSF	BNSF Railway Company
BOS	Back Office Server
CAD	Computer-Aided Dispatch
CFR	Code of Federal Regulations
CN	Canadian National Railway Company
CP	Canadian Pacific Railway Company
CSXT	CSX Transportation, Inc.
DM&E	Dakota, Minnesota, & Eastern Railroad
FRA	Federal Railroad Administration
GCOR	General Code of Operating Rules
GIS	Geographic Information System
GM	General Manager
GTM	Gross Ton-Miles
HMI	Human Machine Interface
IC&E	Iowa, Chicago & Eastern (IC&E) Railroad
IT	Information Technology
ITC	Interoperable Train Control
KCSR	The Kansas City Southern Railway Company
LAN	Local Area Network
LiDAR	Light Detection and Ranging
MGT	Million Gross Ton
MP	Milepost
MTEA	Main Line Track Exclusion Addendum
NMC	Network Management Center
NS	Norfolk Southern Railway Company

Table 1-5: Acronyms Used in Canadian Pacific's Positive Train Control Implementation Plan (Continued)

Acronym	Meaning
NPI	Notice of Product Intent
PIH	Poison by Inhalation Hazard
PMO	Program Management Office
PRA	Probabilistic Risk Assessment
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
RSAC	Rail Safety Advisory Committee
S&C	Signals and Communications
SOX	Sarbanes–Oxley Act of 2002
SVP	Senior Vice President
TIH	Toxic Inhalation Hazard
TMDS	Wabtec Train Management Dispatching System
UP	Union Pacific Railroad Company
U.S.C.	United States Code
V-ETMS	Wabtec Vital Electronic Train Management System
VP	Vice President
WAN	Wide Area Network
WBS	Work Breakdown Structure
WRE	Wabtec Railway Electronics
YL	Yard Limits

Table 1-6 lists key terms along with their definitions and/or references to sources where the definition can be found.

Table 1-6: Definitions of Key Terms Used in Canadian Pacific's PTC Implementation Plan

Term	Definition
Class One 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)).
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.
Main line	Except as provided in 49 CFR § 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 One railroad, as documented in current timetables filed by the Class One railroad with the FRA under § 217.7 of this title, 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. Tourist, scenic, historic, or excursion operations as defined in part 238 of this chapter are not considered intercity or commuter passenger service for purposes of this part.
Main line track exclusion addendum	The document submitted under 49 CFR §§ 236.1011 and 236.1019 requesting to designate track as other than main line.
Notice of Product Intent	Described in 49 CFR § 236.1013. A railroad may, in lieu of submitting a Positive Train Control Development Plan, or referencing an already issued Type Approval, submit a Notice of Product Intent (NPI) describing the functions of the proposed PTC system.
Positive Train Control	Described in 49 CFR § 236.1005.
Positive Train Control Development Plan	Described in 49 CFR § 236.1013. For a PTC system to obtain a Type Approval from FRA, the Positive Train Control Development Plan shall be filed in accordance with 49 CFR § 236.1009.
Positive Train Control Implementation Plan	Required under 49 U.S.C. § 20157 and further described in 49 CFR § 236.1011. By April 16, 2010, each host railroad that is required to implement and operate a PTC system in accordance with 49 CFR § 236.1005(b) shall develop and submit, in accordance with 49 CFR § 236.1011(a), a Positive Train Control Implementation Plan for implementing a PTC system required under 49 CFR § 236.1005.
PTC railroad	Each Class One railroad and each entity providing regularly scheduled intercity or commuter rail passenger transportation required to implement or operate a PTC system.
Positive Train Control Safety Plan	Described in 49 CFR § 236.1015. A PTC System Certification for a PTC system may be obtained by submitting an acceptable Positive Train Control Safety Plan.

Table 1-6: Definitions of Key Terms Used in Canadian Pacific's PTC Implementation Plan (Continued)

Term	Definition
PTC System Certification	Certification as required under 49 U.S.C. § 20157 and further described in 49 CFR §§ 236.1009 and 236.1015. If the Associate Administrator approves the Positive Train Control Safety Plan, the railroad shall receive PTC System Certification for the subject PTC system and shall implement the PTC system according to the Positive Train Control Safety Plan.
Request For Amendment	A request for an amendment of a plan or system made by a PTC railroad in accordance with 49 CFR § 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
Train	One or more locomotives, coupled with or without cars.
Type approval	A number assigned to a particular PTC system indicating FRA agreement that the PTC system could fulfill the requirements of 49 CFR Part 236 Subpart I.

2. Applicable Documents

Provided below is a list of all documents and other sources referenced in this PTCIP.

[1] One Hundred Tenth Congress of the United States of America. *Rail Safety Improvement Act of 2008* (Amendment of Title 49 United States Code). January 3, 2008.

[2] Federal Railroad Administration, US Department of Transportation. 49 CFR Parts 229, 234, 235 et al. *Positive Train Control Systems; Final Rule*. Docket No. FRA-2008-0132, Notice No. 3. January 15, 2010.

[3] Canadian Pacific Railway. *Positive Train Control Notice of Product Intent*. Revision 0.0. April 15, 2010.

[4] Federal Railroad Administration, US Department of Transportation. *PTC Implementation Plan (PTCIP) Template.* January 7, 2010.

[5] Wabtec Railway Electronics, CSX Transportation, Inc., Norfolk Southern Railway Company, and Union Pacific Railroad Company. *Vital Electronic Train Management System (V-ETMS®) Positive Train Control Development Plan (PTCDP).* Version 1.0. March 24, 2010.

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

The means by which the functional requirements of V-ETMS are in full compliance with the mandated requirements for PTC (outlined in Subpart I § 236.1005), are described in detail in the Vital Electronic Train Management System (V-ETMS®) Positive Train Control Development Plan (PTCDP) [5] submitted to FRA on March 24, 2010 for review and subsequent Type Approval. The PTCDP was prepared jointly by Wabtec Railway Electronics (WRE), CSX Transportation, Inc. (CSXT), Norfolk Southern Railway Company (NS), and Union Pacific Railroad Company (UP). The PTCDP was submitted in compliance with Subpart I § 236.1009(b) and includes documentation required by Subpart I § 236.1013.

While CP has every intention of fully deploying the WRE V-ETMS system technology as described in the aforementioned PTCDP [5], CP has decided to take a pragmatic stance with respect to this new technology. CP is therefore submitting a *Notice of Product Intent (NPI)* [3] in fulfillment of 49 CFR 236 Subpart I § 236.1013(e); this in lieu of referencing the full PTCDP submitted March 24, 2010. The technology description, as it applies to this section of the PTCIP, however, discusses the complete WRE V-ETMS in meeting the requirements of § 236.1011(a)(1).

The system described in the PTCDP is based on WRE's V-ETMS, which is an interoperable PTC system developed in compliance with requirements and standards defined through the Interoperable Train Control (ITC) industry effort. V-ETMS consists of components physically and logically divided into four subsystems or segments, including locomotive, office, communications, and wayside segments. V-ETMS is a 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. V-ETMS 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 being deployed, and a high-level description of the functionality of the PTC system, subsystems, and interfaces are all found in the PTCDP. As it relates to the technology being applied to system design and architecture, outlines of the pertinent sections of the PTCDP are referenced below:

> **PTCDP 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 § 236.1013(a)(1).

- 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

PTCDP Section 4, PTC Architecture, which describes how the V-ETMS architecture satisfies safety requirements, as required by 49 CFR § 236.1013(a)(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 Technology
- 4.4 Communications Segment
- 4.4.1 The Messaging System
- 4.4.2 Wireless Networks

The Concept of Operations (CONOPS) [6], as required by 49 CFR § 236.1013(a)(3), is included in Appendix A of the PTCDP [5]. CONOPS addresses each of the PTC functional requirements specified in 49 CFR § 236.1005(a). While CONOPS provides a thorough description of how the PTC system will meet these requirements, for the purposes of this document, the individual requirements are identified below along with a reference to the applicable subsections of Section 5 of CONOPS:

§ 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 49 CFR Part 236 Subpart I 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. This will be the method employed by CP for protecting non-PTC routes at rail-to-rail crossing-at-grade, as all intersecting non-PTC routes are restricted to 40 miles per hour or less.

(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 [2];

(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;

- 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)]

This section summarizes CP's strategy for complying with FRA procedural requirements, and it also identifies key risks that could potentially hinder the successful deployment of a PTC system that meets the various goals and objectives identified in Section 1.2 above. Section 4.1 describes how CP intends to comply with the procedural requirements outlined in 49 CFR § 236.1009, which requires that the host railroad apply for and receive PTC System Certification from the FRA before deploying a PTC system in revenue service. Subsection 4.2 contains a table that identifies the risks associated with the high-level goals and objectives of CP's PTC program, and provided along with a description of these risks are potential consequences, mitigation strategies, and contingency plans for each identified risk.

4.1 Compliance with Procedural Requirements

This PTCIP, which has been generated by CP to meet the requirements of 49 U.S.C. § 20157 and 49 CFR § 236.1011, describes CP's approach for implementing a PTC vital overlay system on all portions of CP's US network for which PTC deployment is required by 49 CFR § 236.1005(b). This plan, which has been submitted in advance of the April 16, 2010 statutory deadline required by 49 CFR § 236.1009(a), will allow for a PTC system certified under 49 CFR § 236.1015 and meeting the requirements of 49 CFR § 236.1005 to be installed on the required portions of track prior to the December 31, 2015 deadline required by 49 CFR § 236.1005. In the event of any additions, subtractions, or other material modifications to one or more of the lines of railroad for which installation of a PTC system is required and addressed by this PTCIP, CP will issue a RFA, in accordance with 49 CFR § 236.1021, using the process previously described in Section 1.1.2 of this PTCIP.

On March 24, 2010, WRE, CSXT, NS, and UP jointly submitted a PTCDP containing the information required by 49 CFR § 236.1013 to the FRA for Type Approval, as set forth under 49 CFR § 236.1009(b)(2)(i). CP has performed a review of the final PTCDP that was submitted to FRA to confirm that all functional aspects of the system, identified in the final submittal, align with Canadian Pacific's needs and that no operational scenarios would be adversely impacted by the implementation of the V-ETMS solution.

CP, however, is submitting a *Notice of Product Intent (NPI)* [3] in fulfillment of 49 CFR 236 Subpart I § 236.1013(e); this in lieu of referencing the full PTCDP [5] submitted March 24, 2010. CP will use the additional time provided by the NPI process to affirm its current understanding of V-ETMS, and CP expects to ultimately reference the anticipated Type Approved PTCDP as a completely satisfactory solution for CP's PTC requirements. In the unlikely event that this further analysis suggests a modified PTCDP is warranted to meet specific requirements for CP, such document will be filed in accordance with 236.1009. CP will be submitting an updated PTCIP with either a complete PTCDP, as defined in § 236.1013(a), or an

updated PTCIP referencing an already approved Type Approval within 270 days after the "Provisional Approval" of CP's PTCIP.

It is CP's intent to achieve FRA PTC System Certification by second quarter, 2012 and to deploy PTC on all required portions of the network by August 15, 2015, such that CP's PTC system will be fully operational by December 31, 2015. In order to achieve FRA PTC System Certification by this date, CP will generate, and submit to FRA for approval by first quarter 2012 (understanding the FRA has specified a 180-day window for approval), a PTCSP meeting the requirements of 49 CFR § 236.1015. If the Associate Administrator approves the PTCSP, CP will receive PTC System Certification for the PTC system addressed in the PTCSP and will implement the PTC system according to the PTCSP.

4.2 Risks to Successful Deployment of PTC

CP has implemented 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:

- Identifies risks to meeting the goals and objectives of CP's PTC deployment;
- Identifies the potential consequences associated with risks;
- Establishes and implements risk mitigation strategies;
- Monitors risk status; and
- Establishes contingency plans.

For the goal/objective categories identified in Section 1.2, Table 4-1 below lists identified high-level risks to achieving the goal/objective, the potential consequences of the risk should it occur, CP's mitigation strategy, and any contingency plans.

Table 4-1: Identified Risks to Canadian Pacific's Successful Deployment of PTC

Ref #	Objective/Goal Category	Risk Descriptions	Potential Consequences	Risk Mitigations	Contingency Plans
1	*Quality and Safety:* 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.	PTC system does not enhance system safety: • Does not prevent train-to-train collisions • Does not prevent overspeed derailments • Does not prevent incursions into established work zone limits • Does not prevent movement of trains through improperly-positioned switches • Creates additional safety hazards that reduce 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.	• PTC system cannot be deployed without modification of system behavior • PTC system cannot be deployed without re-assessment of achieved safety levels • Deployed PTC system cannot obtain FRA Certification • Schedule delay.	• In concert with other Class One railroads, following system development methodology that captures PTC system requirements and provides traceability of those requirements throughout the system life cycle • Rigorous safety program at all levels of system development, with methodologies and activities to be defined in the PTCSP, as required by 49 CFR § 236.1015, to be followed • Ensure that all vendors from whom PTC technologies are to be acquired have an acceptable quality assurance program for both design and manufacturing processes • Working directly with wayside vendors on interim results and providing feedback for enhanced requirements • Deploying wayside hardware that will accept firmware upgrades.	Existing method of operation to be maintained during/after PTC installation until acceptable safety levels have been achieved and FRA Certification has been granted.

Table 4-1: Identified Risks to Canadian Pacific's Successful Deployment of PTC (Continued)

Ref #	Objective/Goal Category	Risk Descriptions	Potential Consequences	Risk Mitigations	Contingency Plans
2	*Quality:* CP will maintain acceptable levels of operation on subdivisions operating under PTC.	CP incurs unacceptable train delays resulting from PTC operation • PTC implementation and/or system design introduces inefficiencies o wireless communication-related delays o Inefficient train operation resulting from braking algorithm • Reduction in efficiency resulting from running unequipped trains through PTC-equipped territory because o Locomotives operating with PTC equipment installed but with equipment outages o Trains not PTC-equipped • Reduction in efficiency of personnel o Ineffective human factors design for PTC equipment o Ineffective and/or insufficient training of personnel.	• CP incurs unacceptable train delays as a result of PTC • PTC deployment is delayed until productivity issues are resolved.	• Reliability program initiated to monitor, report, and improve reliability of equipment • Identify and reach agreement with additional potential tenants for equipping with PTC equipment • Monitor effectiveness of training – quality improvement program in place • System development effort focusing on high technical risk areas to identify and mitigate potential system design and implementation-related contributions to decreased productivity.	Existing method of operation to be maintained during/after PTC installation until acceptable levels of efficiency and productivity have been achieved.

Table 4-1: Identified Risks to Canadian Pacific's Successful Deployment of PTC (Continued)

Ref #	Objective/Goal Category	Risk Descriptions	Potential Consequences	Risk Mitigations	Contingency Plans
3	*System Coverage / Progressive Risk-Based Deployment:* PTC vital overlay system to be progressively deployed across all portions of the CP US network for which PTC deployment is required by 49 CFR § 236.1005(b)	PTC system progressive installation is delayed because of: • Lack of PTC equipment availability • Insufficient availability of radio spectrum • Lack of availability of trained and qualified installers • Ineffective coordination of installation plans result in interference between installation crews where infrastructure is complex and/or working space is limited • Installation procedures become protracted • Acts of nature.	• PTC system will not be progressively deployed across all portions of the CP network for which PTC deployment is required by 49 CFR § 236.1005(b) • Full benefit of safety enhancements will not be realized by required date • CP may incur civil penalties.	• Develop detailed plans for equipping rolling stock, wayside, and office with required PTC equipment • Cooperate with balance of industry to develop radio spectrum allocation and coordination • Develop detailed training and personnel plans • Work closely with vendors and other railroads in close geographic proximity to minimize risk associated with installation procedures and schedule • Establish schedule performance metrics to measure PTC deployment progress, monitor metrics to identify any potential schedule delays, and take action to avert potential schedule delays • Engage multiple suppliers for wayside equipment.	• Existing method of operation to be maintained during/after PTC installation until acceptable safety levels have been achieved and FRA Certification has been granted • Partial deployment on highest risk subdivisions.

Table 4-1: Identified Risks to Canadian Pacific's Successful Deployment of PTC (Continued)

Ref #	Objective/Goal Category	Risk Descriptions	Potential Consequences	Risk Mitigations	Contingency Plans
4	*Interoperability:* The PTC system will provide for interoperability between CP and all tenant railroads.	Interoperability between CP and its tenants is not achieved. • Unsuccessful in deploying interoperable radio and messaging technology • Semantic incompatibility between railroads • Difficulty and/or delay in establishing required interoperability agreements with tenant railroads • Difficulty and/or delay in achieving required levels of technical interoperability.	• PTC system will not be installed across all portions of the CP US network for which PTC deployment is required by 49 CFR § 236.1005(b) • Full benefit of safety enhancements will not be realized by required date • Tenants not permitted to travel on CP network • CP may incur civil penalties.	• Establish organizational structure to facilitate communication and coordination between host and tenant roads • Participate in industry organizations to establish PTC system standards to achieve interoperability by working collaboratively on requirements definition, system/component design, and product testing to deploy interoperable, common technology • Conduct testing to help ensure that implementations conform to industry standards • Establish clear understanding of technical requirements and schedule for interoperability with each tenant road. • Establish performance metrics to measure tenant progress toward equipping rolling stock with interoperable PTC equipment.	• Tenants with which interoperability is not achieved will not be permitted to travel on CP track • Existing method of operation to be maintained during/after PTC installation until acceptable safety levels have been achieved and FRA Certification has been granted • Re-consisting the motive power so that the subject train has a PTC-equipped locomotive in the lead, including supplying a CP PTC-equipped locomotive.

Table 4-1: Identified Risks to Canadian Pacific's Successful Deployment of PTC (Continued)

Ref #	Objective/Goal Category	Risk Descriptions	Potential Consequences	Risk Mitigations	Contingency Plans
5	*Regulatory Compliance:* Achieve FRA PTC System Certification by second quarter 2012	• Required documentation not filed with FRA by required deadlines • The safety methodologies and activities required by 49 CFR § 236.1015 are not sufficiently applied or not sufficiently documented in the PTCSP • Gaps in the validation and verification (V&V) process are uncovered that impact the validity of testing results; or, at worst, the design of the system.	• PTC may not function as required to meet performance requirements • PTC system may not enhance safety levels • PTC system cannot be deployed without modification of system behavior • PTC system cannot be deployed without re-assessment of achieved safety levels • Deployed PTC system cannot obtain FRA Certification • Schedule delay.	• PTCIP describes approach and schedule that CP will follow in order to meet FRA requirements • Rigorous safety program at all levels of system development, with methodologies and activities to be defined in the PTCSP, as required by 49 CFR § 236.1015, to be followed • CP will ensure that all vendors from whom PTC technologies are to be acquired will have an acceptable quality assurance program for both design and manufacturing processes • Periodic testing and documentation process audits will be conducted with vendors.	• Existing method of operation to be maintained during/after PTC installation until acceptable safety levels have been achieved and FRA Certification has been granted • Place in revenue service as much PTC territory as possible upon receipt of certification.

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

This section describes how the PTC vital overlay system to be deployed by CP will provide for interoperability between CP and its tenant railroads on the portions of track that are required to be equipped with PTC per 49 CFR § 236.1005(b). Descriptions of interoperability-related agreements executed between CP and other railroads are provided in Subsection 5.1. Subsection 5.2 provides a summary of how CP plans to obtain technical, semantic, and organizational interoperability to enable PTC to enhance the ability of the railroads to interoperate in a safe manner. Potential obstacles to interoperability, and the steps that are being taken to overcome these obstacles, are then discussed in Section 5.3.

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

An Interoperable Train Control (ITC) collaboration agreement was executed by and amongst four Class One railroads wishing to achieve 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. The collaboration agreement includes a list of interoperability requirements mutually agreed-upon by the parties:

- Definition and adoption of uniform interface standards;
- Definition, adoption and implementation of Association of American Railroads (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 (HMI), allowing an engineer from any of the participant's roads to utilize the system on any participant's locomotives on territory for which the engineer is qualified;
- Adoption of a coordinated plan for configuration management of the interoperable PTC onboard executable software;
- Agreement on use of 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 locomotive engineer, at the start of a trip, to initialize the interoperable onboard system with the back offices of participants' 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.

The ITC collaboration agreement chartered the formation of various technical working committees, each dedicated to some technical aspect of PTC interoperability. Participation in the technical working committees was expanded beyond the chartering roads to include *any* railroad planning to implement an interoperable PTC system and wishing to participate.

Since January of 2009, CP has been an active participant on the ITC technical teams, although not formally party to the ITC collaboration agreement at this time. Through technical team activities, and also through engagements with the principal suppliers of PTC equipment, CP is confident that there is no impediment to adopting the standards and technology arising from this effort in CP's organization, and CP will be able to achieve the required level of interoperability with the other railroads that are formally party to this agreement, as well as other railroads who have a position equivalent to that of CP, who are also active participants in the ITC process.

As previously stated in Section 1.2 of this document and further described in Section 6.3.14, CP has chosen, as a matter of policy, to ensure that all movements made, by host or tenant, on any subdivision where PTC has been deployed, will be PTC equipped by December 31st, 2015.

As per 49 CFR § 236.1011(a)(6)(ii)(A), CP provided formal written notice to all tenants of its policy regarding operation on PTC equipped subdivisions on and after December 31st, 2015, requesting identification of rolling stock to be equipped and the schedule for such equipment to be equipped.

In addition, CP exchanged correspondence with other entities where it operates as a tenant, again in an effort to ensure interoperability where applicable. The end result of this effort identified 26 railroads where some form of agreement or understanding regarding operations between CP and the other party were required. These railroads are:

- Amtrak
- BNSF Railway Company
- Canadian National Railway Company
- CSX Transportation
- Kansas City Southern Railway Company
- Norfolk Southern Railway Company
- Union Pacific Railroad Company
- Consolidated Rail Corporation Shared Assets Organization
- Metra
- Pan Am Southern
- Red River Valley & Western Railroad Company and Rutland Line Inc
- Southern New York Railway
- Wisconsin & Southern Railroad Company
- Kansas City Terminal Railroad
- Metro North

- Belt Railway Company
- North Shore Railroad Company
- Indiana Harbor Belt Railroad Company
- Minnesota, Dakota & Western Railway
- New York, Susquehanna, and Western Railway Corporation
- Delaware-Lackawanna Railroad Company, Inc
- Minnesota Commercial Railway Company
- Minnesota Northern Railroad
- Reading Blue Mountain and Northern
- Twin Cities & Western Railroad Company
- Vermont Terminal Railway

Through examination and discussion with these partners, it was determined that existing operations were conducted in a manner not requiring the tenant to equip their locomotives for PTC with three, namely;

- Indiana Harbor Belt Railroad Company- utilizes CP power when operating on CP trackage
- Minnesota, Dakota & Western Railway- no plan to exercise existing trackage rights
- New York, Susquehanna, and Western Railway Corporation- operate wholly within yard limits on CP.

Where it was identified that the operation required interoperability, as either statutorily required, or as further required by CP policy as defined above, a *Letter of Understanding* (included in Appendix C) was forwarded for consideration by the passenger or freight tenant carrier. Letters have been exchanged with both those that are party to the ITC collaboration agreement and those who at this point are not, and equally with parties who have or have not participated in ITC technical team activities. Similarly, CP, as a tenant, received a *Letter of Understanding* from the host railroads where PTC is to be deployed on routes where CP operates. The letter, *when executed*, establishes agreement between CP and its host and/or tenant in the following areas:

- Implementation of PTC technical solutions which meet the requirements of interoperability as defined in 49 CFR § 236.1003(b);
- 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.

CP has executed this referenced *Letter of Understanding* and is coordinating implementation of an interoperable PTC system in accordance with the interoperability requirements stated in the ITC collaboration agreement with the following 17 of the remaining 23 railroads, where CP is either host or tenant:

- Amtrak
- BNSF Railway Company
- Canadian National Railway Company
- CSX Transportation
- Kansas City Southern Railway Company
- Norfolk Southern Railway Company
- Union Pacific Railroad Company
- Consolidated Rail Corporation Shared Assets Organization
- Metra
- Pan Am Southern
- Red River Valley & Western Railroad Company and Rutland Line Inc
- Southern New York Railway
- Wisconsin & Southern Railroad Company
- Kansas City Terminal Railroad
- Metro North
- Belt Railway Company
- North Shore Railroad Company

Agreements Still Pending. Again, as previously referenced above, on and after December 31, 2015, CP, as a matter of policy, will not permit the operation of unequipped trains on line segments that have been equipped with PTC. To this end, while CP has discussed the execution of the *Letter of Understanding* with the remaining six railroads from the total list of partners above, the parties have not yet concluded satisfactory terms. CP remains committed to ensuring fulfillment of its policy of equipping of all movements in PTC territory, and therefore continues to be in active discussions with the following six tenants regarding this requirement:

- Twin Cities and Western Railroad
- Minnesota Commercial Railway Company
- Vermont Terminal Railway
- Reading Blue Mountain and Northern
- Delaware and Lackawanna
- Minnesota Northern.

All of the above referenced correspondence, both the formal written request and responses received per 49 CFR § 236.1011 (a)(6)(ii)(A) and (B), and the executed *Letters of Understanding* can be found in Appendix C of this document. In addition, correspondence with Amtrak included in Appendix C also addresses the requirement of 49 CFR § 236.1009(a)(3) that CP and Amtrak "jointly file a PTCIP that addresses shared track."

5.2 Technology Applicable to Interoperability [§ 236.1011(a)(3)(ii)]

CP and its interoperability partners will utilize methods in three areas to *obtain* and *maintain* interoperability of its PTC system:

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). Use of and compliance with these common interface definitions ensures the ability to exchange data messages between interoperable system components.

Semantic interoperability is achieved through the common use of documented system behavioral specifications. 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 ensures 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 described above. 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 ensure that interoperability is maintained as the interoperable PTC system(s) are enhanced. ITC and AAR teams also work to establish organizational interoperability in the areas of interchange and infrastructure sharing. Finally, CP has assigned the PMO the responsibility of ensuring organizational communications on PTC interoperability matters with each of its tenant railroads occurs in a timely fashion.

5.3 Obstacles to Interoperability [§ 236.1011(a)(3)(iii)]

Canadian Pacific fully understands the statutory requirement for interoperability. As such, CP acknowledges that reaching agreement with its operating partners is critical to achieving interoperability.

As stated above, CP has yet to reach agreement with six tenants in this regard. However, CP is committed to continuing its dialogue with those tenants and is confident, that through mutually acceptable commercial terms, agreement will be reached to ensure that all movements on PTC-equipped line segments will be operated with a lead locomotive equipped for PTC operation.

In the unexpected event that terms cannot be agreed upon with any of the remaining tenant railroads, CP will examine alternative operations with the tenant that mitigate the risk and do not require any unequipped train access to PTC-controlled track.

As a tenant railroad, CP also foresees no obstacles to achieving full interoperability with any and all host railroads that operate a wayside equipped for PTC certified as conforming to the specifications being established by the ITC consortium, and that also exchange the requisite information for operating a train as established by the ITC consortium.

CP intends to subject its PTC back office, wayside infrastructure, and locomotive equipment for certification or install equipment already type-certified for interoperability as appropriate.

6. Installation Risk Analysis [§ 236.1011(a)(4)]

6.1 Introduction

This section describes the risk prioritization model generated in response to 49 CFR § 236.1011(a)(4), which requires that, to the extent practical, the PTC system be implemented to address areas of greater risk to the public and railroad employees before areas of lesser risk. The risk prioritization model assesses a number of key risk factors, which are assumed to provide an indication of the relative risk associated with the CP subdivisions where PTC is to be installed. The relative risk rankings generated by this model provided the basis for prioritizing deployment of PTC on the CP subdivisions for which PTC is required by 49 CFR § 236.1005(b). The risk prioritization model did not assess other CP subdivisions for which PTC deployment is not required. This section of the PTCIP describes the risk prioritization approach, the risk factors that were assessed, and the model results.

6.2 Risk Prioritization Model Approach

The risk prioritization model used by CP is based heavily on the sample methodology provided by the FRA in the *Risk Prioritization Methodology for PTC System Implementation* [7] (hereafter referred to as the *Risk Prioritization Template*). The specifics of the model were developed by Battelle Memorial Institute in cooperation and consultation with CP. This model was then shared and further refined through consultation with representatives of the six other Class One Railroads.

This is a basic weighted score approach in which a number of risk factors, as identified in the *Risk Prioritization Template* and *PTC Implementation Plan Template* [4], were assigned integer scores, corresponding with level of risk, ranging from 0 (lowest risk) up to 5 (highest risk) for each of the CP subdivisions to be equipped with PTC. Each risk factor was also assigned a weight, which provided an indication of the "relative importance" of the factor in determining the overall risk ranking. Equation 6-1 below shows how, for *n* risk factors, a relative risk score was generated for each subdivision by multiplying the integer score assigned to the subdivision for a given factor (FR_i) by the weight assigned to that factor (FW_i), and summing the products of the *n* risk factors.

(Equation 6-1) *Relative Risk Score for Subdivision* = $$\sum_{i=1}^{n} FR_i \, FW_i$$

In order to perform the above calculation, the following activities were undertaken:

Activity #1 – Identify risk factors to be included in the risk prioritization model

Activity #2 – Estimate risk factor weights (FW_i)

Activity # 3 – Define the risk factor levels (generally from 0 to 5) that would be used to assign scores to the subdivisions for each risk factor

Activity #4 – Assign integer scores (FR_i) to each subdivision using the criteria defined in Activity #3 above.

Details of each of the activities listed above are provided in the subsections following.

6.2.1 Identification of Risk Factors

The *Risk Prioritization Template* includes a list of seven risk factors, which it identifies as "minimum critical risk factors that must be addressed" in the risk prioritization model. These seven risk factors, which are listed below, correspond with the risk factors identified in 49 CFR § 236.1011(a)(5) as minimum factors that shall be used to determine the sequence in which track segments will be equipped:

1. Annual million gross ton (MGT) levels
2. Presence and volume of passenger traffic
3. Presence and volume of TIH/PIH material (loads and residue) transported
4. Number of tracks
5. Method of operation
6. Speeds of train operations
7. Track grades and curvatures.

In addition to the seven "minimum critical risk factors that must be addressed," the *Risk Prioritization Template* also identifies the following 11 "other route attributes bearing on risk that may be considered":

1. Rail traffic density
2. Trip length for route
3. Track type, class, and maintenance schedule
4. Presence or absence of block signal, train control, or cab signal systems
5. Presence or absence, and types, of wayside hazard detectors
6. Number and types of at-grade crossings (both highway-rail and rail-to-rail)
7. Frequency and location of track turnouts
8. Public venues along the route (high population density, stations, events, places of congregation, etc.)
9. Presence of other equipped and non-PTC-equipped traffic along the route (shared track)
10. Past accident/incident statistics
11. Hazards to human health and the environment.

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

This section describes the decision basis for line segments to be equipped with PTC, as well as the sequence and planned schedule for PTC deployment. A proposed schedule for commencing revenue-service PTC operations by December 31, 2015 on all required subdivisions is included. The schedule identifies groups of subdivisions, the timeframe in which PTC operations for that group of subdivisions will commence, and other supporting task completion dates. The schedule is supported by information related to the scheduling of rolling stock and field locations. Finally, this section addresses the potential for future modifications to the operating conditions on CP's network within the expected life-cycle of the PTC system.

7.1 Decision Basis

In developing a proposed schedule for commencing revenue service of PTC operations by December 31st 2015, emphasis was placed on adhering to the results of the risk prioritization model described in Section 6. As discussed in Section 6, the risk prioritization model calculates the relative risk associated with the various CP subdivisions by assessing subdivision traffic characteristics, operational characteristics, and other route attributes.

All of the characteristics/attributes assessed in the model are described in detail in Section 6 and the subdivision data for these characteristics/attributes are included in the risk prioritization model spreadsheet provided in Appendix E of this PTCIP. The GIS shape files provided in Appendix D also contain data on the characteristics/attributes of the subdivisions to be equipped with PTC.

While the risk prioritization model results provided in Subsection **Error! Reference source not found.** were the primary consideration when generating the sequence and schedule of subdivisions to be equipped, minor latitudes were taken in effort to avoid creating "islands" of equipped territory, particularly in light of home terminal locations for running trades employees, to ensure, wherever possible, either contiguous, or home terminal specific corridor deployment. These minor exceptions are described in detail in Section 11.

7.2 Field Deployment Approach

Once field construction and testing of signals and communications equipment has been completed on a subdivision, a period of testing of office to field will commence. It is expected that some 30 days of end-to-end testing of functionality will be required prior to a subdivision being commissioned for revenue service. During this thirty-day period, final training and certification of running trade employees, roadway workers, supervisors and other affected employees will be completed. The specifics of these test and training plans will be provided in detail in CP's PTCSP, in accordance with 49 CFR § 236.1015.

7.3 Train Deployment Approach

As described in Section 8, CP will commence equipping rolling stock in January of 2012. It is planned that some 176 locomotives, or approximately 31% of the U.S. fleet, will be equipped by the end of 2012. A further 156 locomotives, for a total of 332, or approximately 59% of the required fleet will be equipped by year end 2013. This number of locomotives will facilitate the PTC revenue service operation of the subdivisions planned to be commissioned in 2013.

Similarly, it is planned that the addition of a further 156 PTC equipped locomotives, providing for some 87% of required locomotives, will permit the operation of the additional trackage commissioned in 2014. In 2015, as outlined in Sections 8 and 9, CP will complete the commissioning of the remainder of its PTC network and equip the final 75 locomotives, providing for PTC operation on the track segments requiring PTC as described in Section 1.4.

It should be noted, that while CP will make all reasonable effort to maximize the number of equipped trains operating on PTC-equipped lines during this transition period, as locomotives are not assigned to specific trains, there is not a direct correlation of percentage of locomotives equipped to percentage of equipped trains operating on a given PTC subdivision. CP has developed a set of interim goals as required by 49 CFR 236.1006(b)(1), with reference to the number of PTC-equipped trains it expects to operate on the PTC subdivisions as they become commissioned. These specific goals are listed in Section 1.3.

7.4 Deployment Sequence and Schedule

Table 7-1 below identifies the proposed sequence and schedule for commencing revenue-service PTC operations by December 31, 2015 on all required subdivisions. The schedule groups subdivisions into four separate deployment groups, which are referred to in this table as ‘Group One’, ‘Group One A’, ‘Group Two’ and ‘Group Three’. For each subdivision, the schedule identifies the expected completion date for field construction, the expected completion date for testing and training, and the date by which it is expected that the subdivision will be commissioned for revenue PTC service.

Table 7-1: Subdivision Commissioning Schedule

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7.5 Planned Modifications

If changes to the operating conditions on the railroad were anticipated within the expected life-cycle of the PTC system, such changes could potentially affect the planned deployment sequence and schedule. There are currently no confirmed planned modifications to the operating conditions of CP's network at the time of this filing, but CP is presently assisting the Wisconsin Department of Transportation to develop an expanded passenger rail system in the State of Wisconsin.

Selected railway infrastructure investment is being planned to assist reliability for existing Amtrak trains on the CP corridor south of Milwaukee. Plans for more substantial investment to be added to the CP Milwaukee-to-Watertown corridor to provide capacity for up to six additional round-trip passenger trains, possibly commencing sometime in 2013, are also being discussed. It is envisioned that these trains will continue onward to Madison, operating on track owned by the State of Wisconsin.

CP owns a segment of track between Madison and Madison Airport, a distance of about four miles, on which up to six higher speed passenger trains may be added in 2013 as part of the High Speed Rail Initiative of the Wisconsin Department of Transportation. The precise details of the service that may be offered on this segment of track are not yet known or specified.

CP anticipates that the Wisconsin Department of Transportation may be engaging Amtrak to operate any expanded passenger services in Wisconsin, hosted on track and land owned by both CP and the State. Once such plans and details become finalized, CP will file an RFA to cover such changes, where deemed necessary.

8. Rolling Stock [§ 236.1011(a)(6)]

This section contains information related to the CP rolling stock that will be equipped with PTC technology. It provides an overview of the CP locomotive fleet, identifies the quantity and type of locomotives to be equipped with PTC, and it includes a schedule for equipping the identified quantities of locomotives. This section also summarizes the actions that have been taken to date to ensure tenant railroads will equip rolling stock with compatible PTC for operation on CP's PTC territories.

8.1 CP Locomotive Fleet Overview

The CP locomotive fleet consists of a total of 1425 locomotives built by either General Electric Transportation (Erie, Pennsylvania) or Electromotive Diesel (LaGrange, Illinois). CP employs locomotives utilizing both AC and DC traction motor technology. Locomotives are classified by type of service, with units in either road service or low gross ton-mile (GTM) road and switcher service.

Units of lower horsepower are normally assigned to designated yard or terminal operations while the high horsepower locomotive fleet is usually assigned to road or through freight service. In road service, CP uses locomotives of the SD40, SD60, SD90MAC and AC4400 (including EVO) manufacturer types. In low GTM road service, CP employs units of GP9, GP38, GP40 and SD40 class.

The active locomotive fleet at any given time will vary depending on the current traffic levels and operating service plan requirements.

As a general rule, CP maintains a 1.5 ratio of lead to trail in its road fleet, and as close to 100% lead equipped for units assigned to low GTM service.

In developing its PTCIP, CP reviewed its overall locomotive fleet assignments, as well as its integrated operating plan to determine the best strategy for meeting its PTC objectives.

CP has determined that all units employed in U.S and cross-border road service shall be PTC equipped, employing an existing 1.5 ratio of lead to trail in the road fleet. This plan will ensure that all trains operating across the border from Canada will have PTC-equipped locomotives in the lead position when they enter the United States.

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

As part of the PTC implementation initiative, CP will equip 455 of its road locomotives and 108 of its low GTM road and switcher service locomotives, for a total of 563 units. These numbers include an allocation for operation of the DM&E property.

Once all PTC implementations are complete, including units in trail only configuration, CP will have equipped over 70% of its total US mainline freight road haul locomotives and 100% of its low GTM road fleet assigned to US operations. This will provide adequate quantity of PTC-equipped locomotives to protect all CP freight and work train operations as well as local and yard switching operations on PTC-equipped tracks.

8.3 PTC Implementation Schedule [§ 236.1011(a)(6)(ii)]

In preparation of CP's 2010 proof of concept of PTC, the company plans to equip approximately 20 locomotives with PTC technology. These units are being selected from the SD40, GP38, AC4400, and EVO classes.

The purpose of this work is to assess and evaluate the optimum equipment layout and installation procedure on a representative range of road locomotives in both service classes and to test and prove out onboard equipment and configurations. It is expected that this test period will last through 2011.

Full scale rollout of PTC installation on the CP US locomotive fleet is scheduled to start in 2012, with a minimum of 156 locomotives to be equipped in each of the calendar years 2012, 2013 and 2014. The remaining 75 locomotives will be completed in 2015.

As CP becomes more familiar with installation of the equipment, this schedule may be accelerated. The numbers expressed below reflect a conservative approach to installations, given fluctuation in demand of fleet size, winter maintenance and other such considerations.

The schedule for installation of PTC onboard equipment is as follows:

Table 8-1: Locomotive Installation Schedule

Year	Number to be Equipped	Total Equipped at Year End	Percentage of 563 Unit Total
2010	20	20	3.5%
2011	Evaluation Period		
2012	156	176	31%
2013	156	332	59%
2014	156	488	87%
2015	75	563	100%

In order to ensure uniformity and efficiency of PTC equipment onboard installation, CP expects to assign this work to two main shops. Installation of PTC equipment on CP locomotives will be performed by CP employees whenever possible. Technical assistance and guidance will be provided by technical service personnel from the PTC equipment suppliers or other industry technical resources as required.

In the event that internal CP resources are inadequate to maintain the forecast PTC equipment installation schedule, CP will increase the number of facilities performing this modification and/or contract equipment installation activities to external contract facilities as required. Prior to contracting PTC equipment installation activities, CP will undertake a review and assessment of the technical expertise and ability of the external facility to undertake the PTC installation workload.

As locomotives attrite from the CP fleet, they will be removed from the PTC implementation plan and other locomotives will be added to maintain the overall targeted number of PTC-equipped locomotives. In the future, if locomotive manufacturers become capable of supplying new locomotives that are PTC-equipped and enabled from the factory, CP will pursue this option for new locomotive purchases as a component of its strategy for achieving locomotive PTC implementation targets.

In accordance with rule 49 CFR § 236.1006(b)(2) CP will report its progress toward achieving its planned PTC locomotive deployment by April 16 of years 2011, 2012, 2013, and 2014.

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

Tenant railroads operating on CP track include most of the Class One freight railroads, Amtrak, and the Class Two and Class Three railroads that have been identified in Section 5 of this document.

For the purposes of this PTCIP submission, CP has signed Letters of Understanding with the Class One railroads that operate on CP, and with Amtrak. As previously described, CP is working directly with all other Class One railroads through the ITC process. All primary tenants, that is, Class One railroads, and Amtrak are submitting PTCIP documents independently that contain all required details of their rolling stock and their PTC deployment plans. Hence, this information is not duplicated here.

Commitments have been made by CP's Class One tenants and Amtrak to implement technical solutions which meet the interoperability requirements as defined in 49 CFR § 236.1003(b). Further, these commitments include the expressed desire to participate in testing programs to verify functionality and interoperability, and to exchange technical information as needed to ensure implementation of PTC in accordance with the applicable FRA requirements.

CP has provided formal written notice to its Class Two and Class Three tenant railroads advising them of CP's plans for PTC and to solicit information as to each organization's intent with regards to PTC. As described in Section 5, agreement has been reached with several Class Two and Three tenants to equip locomotives so that they may be interoperable with CP when operating as a tenant on CP trackage.

Similar Letters of Understanding have been signed with those Class Two and Class Three tenants that have agreed to equip. The list of all 26 of Canadian Pacific's interoperability partners, and the status of such interoperability discussions is contained in Section 5. Copies of all correspondence with these 26 railways, and the responses received, are contained in Appendix C.

As described in Section 5, discussions regarding mutually acceptable commercial terms for interoperable operations continue with six of the 26 railroads. These Class Two and Three tenants are shown as "negotiations continue" in Table 8-2.

A summary of all tenants, and the rolling stock to be equipped, where applicable, is provided below.

Table 8-2: Class Two and Three Tenant Rolling Stock to be Equipped

Tenant Railroad	Equipping (Y/N)	Rolling Stock to be Equipped
Red River Valley and Western Railroad Company and Rutland Line Inc.	Yes	9 Locomotives
Wisconsin and Southern	Yes	15 Locomotives
North Shore Railroad	Yes	5 locomotives
Pan Am Southern	Yes	78 locomotives
Southern New York Railway	Yes	1 locomotive
Belt Railway of Chicago	Yes	5 locomotives. CP to provide power for CP transfers
Reading Blue Mountain and Northern		Negotiations continue
Delaware and Lackawanna		Negotiations continue
Minnesota Commercial Railway		Negotiations continue
Twin Cities and Western		Negotiations continue
Vermont Terminal Railway		Negotiations continue
Minnesota Northern		Negotiations continue
Indiana Harbor Belt Railway	N/A	CP to provide power for CP transfers
New York Susquehanna and Western	N/A	Operate within yard limits only
Minnesota Dakota and Western	N/A	No plan to exercise rights

9. Wayside Devices [§ 236.1011(a)(7)]

This section addresses the wayside equipment which will be installed for the PTC system. It identifies the devices to be installed and the construction tasks required for installing the devices in non-signaled and signaled territories. The equipment to be installed at each base radio location and the construction tasks required to install the equipment at each location is also described. A proposed schedule for installation of the PTC wayside devices by December 31, 2015 is included. The schedule groups subdivisions, the timeframe in which the installation is planned for that group, and other relevant task completion dates.

9.1 Wayside Deployment Construction Tasks for Non-Signaled Territory

In non-signaled territory, the construction tasks are as follows:

- Install a switch circuit controller, conduit and signal cable at every main track switch.
- Install a communication housing, including retaining wall, ground rod network, fill, foundations, solar panels or connect AC power feed, and connect the signal cable to the terminals inside the communication housing at every main track switch. The communication housing will include a Wayside Interface Unit (WIU), PTC radio, DC-DC converter, batteries, power cable and track switch interface cable.
- Install an antenna at each main track switch location. Some antenna installations will require the installation of a foundation, antenna mast, antenna, coaxial cable, and polyphasor. Other antenna installations will require attaching a mast to the existing housing and the installation of the antenna, coaxial cable and polyphasor.

9.2 Wayside Deployment Construction Tasks for Signaled Territory

In signaled territory, the construction tasks are as follows:

- Install a PTC radio, DC-DC converter, WIU, power cable, and interface cable in the existing signal/control location housings, configure and connect the cables to the signal circuits.
- Install an antenna at every signal, DTMF controlled switch and/or control location. Some antenna installations will require the installation of a foundation, antenna mast, antenna, coax cable and polyphasor. Other antenna installations will require attaching a mast to the existing housing and the installation of the antenna, coaxial cable, and polyphasor.

9.3 Wayside Deployment Construction Tasks for Base Radio Locations

In both signaled and non-signaled territory, the following work will be performed at each base radio location:

- Install a PTC radio
- Install a PTC antenna on the existing tower and run cable into the radio site, or
- In some areas install a new tower
    - Move existing equipment from old to new tower
    - Install a PTC antenna on the new tower
- Run cables into the radio site
- Radio site to be connected to the Dispatch office by cell link, leased circuit, microwave system or fiber system interface, depending on availability and cost.

9.4 Wayside Installation Considerations

In order to square the results of the risk assessment found in Section 6 with provisions for seniority territories and other collective agreement considerations to which CP is bound, construction will commence and be completed by three separate workforces. The first, assigned to the Chicago and St Paul Service Areas, the second to the Northeast US Service Area, and the third to the DM&E. Work is scheduled to commence in all three work zones during the construction season of 2012 and will be complete in the second quarter of 2015.

Prior to this production phase of wayside construction, CP intends to install wayside equipment for the purposes of testing and evaluation on the Ottumwa Subdivision in Iowa. This work is scheduled to commence during the construction season of 2010 and be completed by March 2011. This work, coupled with the equipping of some twenty locomotives with onboard PTC equipment, as outlined in Section 8, will allow CP to conduct end-to-end field testing of the various components to be employed in the production system, and to provide evidence for the safety case for the PTC system to be deployed on the balance of CP's PTC-equipped network. This test and evaluation period is scheduled from January 2011 to the end of the second quarter in 2012. The construction dates for the Ottumwa Subdivision in Table 9-1 match this timeframe.

In keeping with the description of major tasks, the production phase of the wayside PTC work is scheduled in three major components per line segment; 1) wayside signal, 2) wayside communication, and 3) wayside tower work. In the detailed schedule found in Appendix B, CP outlines the proposed approach to this work, outlining start and finish dates for each task on each subdivision. Consideration is given to the type of work, number of installations, seasonal weather impacts, and number of man hours required to perform each major task on a given subdivision. This approach to the scheduling results in the most efficient and continuous approach to the labor required, while delivering final construction end dates in keeping with the results of the aforementioned line segment risk assessment.

9.5 Wayside Construction Schedule

Table 9-1 below identifies the proposed sequence and schedule for completing wayside construction on all required subdivisions. The schedule groups subdivisions into four separate deployment groups, which are referred to in this table as 'Group One', 'Group One A', 'Group Two', and 'Group Three'. For each subdivision, the schedule identifies the expected start and finish dates for field construction, the miles of each subdivision that will be equipped with PTC, and the number of devices to be installed.

Table 9-1: Wayside Construction Schedule

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The above will provide for a wayside construction completion schedule as follows:

Table 9-2: Wayside Construction Completion Schedule

Year End	Miles Started	% of PTC Deployment	Miles Completed	% of PTC Deployment
2010	Pilot territory construction			
2011	Evaluation period			
2012	1205.9	44%	104.2	4%
2013	2077.8	76%	1574	58%
2014	2736.8	100%	2348.6	86%
2015			2736.8	100%

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

Section 1.4, specifically Table 1-2, Table 1-3 and Table 1-4 identify all portions of track in the United States for which CP is considered the host railroad. These tables include the information required to identify which segments of CP's US rail network are considered "main line" per the definition provided in 49 CFR § 236.1003, and track meeting the definition of main line are specifically identified in these tables.

For each subdivision, Table 1-2, Table 1-3 and Table 1-4 identify 1) the maximum gross tonnage that traveled on any segment of the subdivision in 2008, 2) the number of cars traveling on the subdivision carrying poison- or toxic-by-inhalation (PIH or TIH) loads or residue in 2008, 3) the average number of passenger trains per day which traveled on any portion of the subdivision in 2008, 4) the subdivision milepost range, 5) the milepost ranges of main line track, per the definition of main line in 49 CFR § 236.1003, 6) the milepost ranges of track not meeting the definition of main line, 7) and the milepost ranges of track that CP will be equipping with PTC.

As discussed further in Section 13, if a railroad has a main line that it believes should be considered not main line, it may file with the PTCIP a main line track exclusion addendum (MTEA) that seeks to have a particular track segment deemed as other than main line. This PTCIP, however, does not include any MTEAs, and therefore, all track identified as main line in Table 1-2, Table 1-3, and Table 1-4 has, in fact, been treated as main line for the purposes of this PTCIP.

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

As outlined in Section 7, CP's PTC deployment schedule closely follows the unrestricted results of the risk assessment included in Section 6 of this document. Minor changes in deployment order were, however, made to avoid creating non-contiguous islands of PTC territory where possible.

When this methodology resulted in a schedule that varied in any significant way from the results of the risk assessment, a compromise approach of deploying by home terminal territory for the Company's running trades employees was added. The end result of the Company's deployment schedule employs a mix of these two approaches, while still delivering to the intent of 49 CFR § 236.1011(a)(4).

As the field construction is commencing simultaneously on all three territories, namely; the Chicago/St Paul Service Area territory, the Northeast US Service Area territory, and the DM&E territory, the three territories have been split and assigned numeric values to deployment groups that match the order of completion described in Section 7. The only exceptions from a strictly risk-based prioritization are those highlighted in Table 11-1 below.

The Watertown Subdivision was moved to deployment group sequence number two in order to match PTC deployment with the single crew run from Portage, Wisconsin to Chicago, Illinois. This small change in order was done to avoid confusion for the operating crews by having to change from PTC to non-PTC territory in the middle of a tour of duty. The risk score of the Watertown Subdivision was deemed in the same range as the scores assigned to the River and Tomah Subdivisions, respectively.

Similarly, the Chicago and Kansas City Subdivisions were moved up slightly in sequence, again to avoid creating non-contiguous corridors of PTC territory. Risk ranking scores were again deemed to be within the same range as those subdivisions moved down in the deployment order.

As previously noted elsewhere in this document, the Ottumwa Subdivision on the DM&E property will be used as the Company's PTC pilot territory, and will therefore be PTC equipped in advance of any other subdivision on the network.

The grouping of the Merriam Park, Withrow, Canadian Connector, Colonie and Bay Subdivisions with the adjacent line segments was performed in order to leverage synergies associated with available construction forces, as these smaller line segments are adjacent to larger, higher risk segments. Again these minor changes in order were done to facilitate construction force availability, training of running trades employees, and to provide geographic deployment groupings to avoid adding confusion to the operation associated with moving in and out of PTC-equipped territory.

Table 11-1: Exceptions to Risk-Based Prioritization

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

Canadian Pacific's US network, for the purposes of this PTCIP, consists of some 3,975 route miles on three service areas and the DM&E. Unlike other Class One railroads operating in the United States, CP's network is very linear in nature, with few, if any, opportunities for duplication of routes between major points.

As outlined in this PTCIP, CP intends on equipping some 2,736 route miles of this network, excluding 69 miles of yard limits, in order to comply with the requirements of 49 CFR Part 236, Subpart I. This deployment, including the yard limits, represents some 71% of Canadian Pacific's total 3975 route miles. As described in Section 1.4, the subdivisions and spur tracks that comprise the remaining 1170 route miles have extremely low traffic volumes, well below the 5 MGT density threshold, save for the Owatonna Subdivision, which handled slightly more tonnage than threshold, at 6.8 MGT, but saw no TIH volume. Therefore, there are no criteria present to warrant consideration of additional PTC deployment at this time.

Given further the present uncertainty of the requirements that may ultimately be contained in the regulations for the implementation of 49 USC 20156, CP can find no compelling further risk to, or benefit associated from, the equipping of additional line segments beyond those required under 49 CFR Part 236, Subpart I at this time.

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13. Main Line Track Exclusion Addendum [§ 236.1019]

If a railroad has a main line that it believes should be considered not main line, it may file with the PTCIP a main line track exclusion addendum (MTEA) that seeks to have any particular track segment deemed as other than main line. Since 49 CFR Part 236, Subpart I only provides for such regulatory flexibility as it applies to passenger transportation routes or segments where limited or no freight railroad operations occur, only a passenger railroad may file an MTEA as part of its PTCIP. This section is, therefore, not applicable to CP's operations, and CP is not filing a MTEA with this PTCIP.

14. Appendices

The following appendices are included as a part of this PTCIP:

- **Appendix A – Review of Previous Studies Applicable to Risk Prioritization Model:** This appendix summarizes reviews of previous research related to the railroad risk factors that were considered in the risk prioritization model described in Section 6. The findings of these reviews were considered when estimating the risk factor weights that were used in the risk prioritization model.
- **Appendix B – Detailed Construction Schedule:** The production phase of the wayside PTC work is scheduled in three major components per line segment; 1) wayside signal, 2) wayside communication, and 3) wayside tower work. The detailed schedule found in this appendix outlines the proposed approach to this work, outlining start and finish dates for each task on each subdivision. Consideration is given to the type of work, number of installations, seasonal weather impacts, and number of man hours required to perform each major task on a given subdivision. This approach to the scheduling results in the most efficient and continuous approach to the labor required, while delivering final construction end dates in keeping with the results of the line segment risk assessment.
- **Appendix C – Correspondence with Tenant Railroads:** Correspondence with tenant railroads is included in this appendix. As described in Section 5 of this PTCIP, CP has signed a *Letter of Understanding* with each of the Class One railroads that operate on CP, and with Amtrak. In addition, correspondence with Amtrak also addresses the requirement of 49 CFR § 236.1009(a)(3) that CP and Amtrak "jointly file a PTCIP that addresses shared track."

  CP has also provided formal written notice to its Class Two and Class Three tenant railroads advising them of CP's plans for PTC and to solicit information as to each organization's intent with regards to PTC. A *Letter of Understanding* has also been signed with those Class Two and Class Three tenants that have agreed to equip. Negotiations are on-going with six other Class Two and Class Three tenants with whom agreement has not yet been reached. Copies of all letters written to Class Two and Three tenant railways, and the responses received, are contained in this appendix.

  This appendix includes the following electronic files, which have been separately provided along with this PTCIP document:

  - Appendix A.1 – Amtrak.pdf
  - Appendix A.2 – BNSF Railway Company.pdf
  - Appendix A.3 – Canadian National Railway Company.pdf
  - Appendix A.4 – CSX Transportation, Inc.pdf
  - Appendix A.5 – Kansas City Southern Railway Company.pdf
  - Appendix A.6 – Norfolk Southern Railway Company.pdf
  - Appendix A.7 – Union Pacific Railroad Company.pdf

- Appendix A.8 – Belt Railway Company.pdf (updated letter for Version 1.0)
- Appendix A.9 – Consolidated Rail Corporation Shared Assets Organization.pdf
- Appendix A.10 – Delaware-Lackawanna Railroad Company, Inc.pdf
- Appendix A.11 – Indiana Harbor Belt Railroad Company.pdf
- Appendix A.12 – Metra.pdf
- Appendix A.13 – Minnesota Commercial Railway Company.pdf
- Appendix A.14 – Minnesota Northern Railroad.pdf
- Appendix A.15 – Minnesota, Dakota & Western Railway.pdf
- Appendix A.16 – New York, Susquehanna, and Western Railway Corporation.pdf
- Appendix A.17 – North Shore Railroad Company.pdf (updated letter for Version 1.0)
- Appendix A.18 – Pan Am Southern.pdf
- Appendix A.19 – Reading Blue Mountain and Northern.pdf
- Appendix A.20 – Red River Valley & Western Railroad Company and Rutland Line Inc.pdf
- Appendix A.21 – Southern New York Railway.pdf
- Appendix A.22 – Twin Cities & Western Railroad Company.pdf
- Appendix A.23 – Vermont Terminal Railway.pdf
- Appendix A.24 – Wisconsin & Southern Railroad Company.pdf
- Appendix A.25 – Metro North Railroad Company.pdf
- Appendix A.26 – Kansas City Terminal Railroad.pdf

- **Appendix D – Canadian Pacific US Rail Network PTC GIS Shape Files:** GIS shape files containing mapping of portions of CP's US rail network that are to be equipped with PTC are being submitted to FRA as separate electronic files. For each CP subdivision that is to be equipped with PTC, these files provide a visual map and data including owning railroad; distance; signal system; track class; number and location of sidings; maximum allowable speed; number and location of mainline tracks; 2008 volume of gross tonnage; 2008 number of cars carrying hazmat; 2008 number of cars carrying PIH; 2008 passenger traffic volume; 2008 average daily through trains; WIUs; switches; and at grade rail-to-rail crossings.

  This appendix includes the following electronic files (updated to include DM&E subdivisions in PTCIP Version 1.0):

  - BrEvent_new.dbf
  - BrEvent_new.prj
  - BrEvent_new.sbn
  - BrEvent_new.sbx
  - BrEvent_new.shp
  - BrEvent_new.shx
  - CrEvent_new.dbf
  - CrEvent_new.prj
  - CrEvent_new.sbn
  - CrEvent_new.sbx
  - CrEvent_new.shp
  - CrEvent_new.shx
  - LnPTC_new.dbf
  - LnPTC_new.prj
  - LnPTC_new.sbn
  - LnPTC_new.sbx
  - LnPTC_new.shp
  - LnPTC_new.shx
  - SwitchPTC_new.dbf
  - SwitchPTC_new.prj
  - SwitchPTC_new.sbn
  - SwitchPTC_new.sbx
  - SwitchPTC_new.shp
  - SwitchPTC_new.shx

- **Appendix E – Risk Prioritization Spreadsheet:** The Microsoft Excel spreadsheet that was used to perform the risk prioritization model calculations described in Section 6 of this PTCIP is being submitted to FRA as a separate electronic file.

  The 'Summary' worksheet contained within this Excel file contains columns with the following information:

  - **Subdivision** – Names of each of the 28 subdivisions to be equipped with PTC.
  - **Subdivision Risk Ranking** – Each subdivision was assigned a risk ranking from 1 to 28, based on the risk calculations performed in the worksheet. The subdivision ranked #1 was assessed to have the highest risk, and the subdivision ranked #28 was assessed to have the lowest risk.
  - **Subdivision Risk Score –** Risk values calculated for each subdivision are included. These values were only used to provide a means of measuring relative risk; they have no real meaning in terms of absolute risk.
  - **Risk Factors –** Row one identifies the risk factors that were assessed in the risk prioritization model.
  - **Risk Factor Weights –** The weight assigned to each risk factor is included in the second row of the spreadsheet.
  - **Risk Factor Level Upper Limits –** The upper limits defined for each risk factor level are defined in rows three through eight under each risk factor heading.
  - **Risk Factor Data and Risk Factor Levels** – Under each risk factor heading (row one) are two columns. The left column contains the data values that were used to assess each subdivision. The right column contains the risk factor levels (typically an integer between 0 and 5) assigned to each subdivision.

  In addition to the 'Summary' worksheet, the Excel file also includes worksheets that contain the data that were used to assess the relative risk of the various subdivisions. A total of 13 additional worksheets, one for each risk factor, are included.

Appendix A: Review of Previous Studies Applicable to Risk Prioritization Model

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Appendix B: Detailed Construction Schedule

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Appendix C: Correspondence with Tenant Railroads

Appendix D: Canadian Pacific US Rail Network PTC GIS Shape Files

Appendix E: Risk Prioritization Spreadsheet