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DEVELOPMENT OF ENHANCED OVERLAY POSITIVE TRAIN CONTROL (EO-PTC)

SUMMARY

Transportation Technology Center, Inc. (TTCI), with support from the Federal Railroad Administration, researched a new mode of train control to increase operational efficiency where Positive Train Control (PTC) equipment has been installed and is operational.

TTCI developed a concept of operations (ConOps), safety analysis report, and an implementation and cost drivers analysis for an Enhanced Overlay Positive Train Control (EO-PTC) System.

The fundamental concept of EO-PTC is that signal-based speed restrictions will be eliminated within blocks governed by Approach and Advance Approach indications when the PTC onboard is in the “Active” state. The requirement for the crew and PTC to bring the train to a stop prior to a signal indicating “Stop” is not relaxed. This concept is applicable to railroads that use route signaling, not speed signaling.

The EO-PTC concept can be safely implemented at minimal cost with no changes to onboard hardware or software. The efficiency gains over current PTC operations are most apparent in:

- Busy corridors or where train fleeting is used to reduce meets and passes, where reduced headways can result in incremental capacity improvements.
- Recovery from service disruptions where multiple trains have been stopped.

- Scenarios where multiple trains queue waiting for departure from a yard or terminal.

Railroad operating rules will have to be modified to eliminate the speed restrictions traditionally associated with Approach and Advance Approach signal aspects in EO-PTC territory. Train crews are responsible for stopping a train short of a stop indication, without relying upon the onboard display to determine braking distance.

Since EO-PTC does not alter the fundamental safety principles of current PTC operations, the Safety Analysis determined that EO-PTC does not result in increased risk for most of the hazards analyzed. Risk may increase if the consist data provided to the onboard segment contains large errors in the number of cars.

TTCI recommends that railroads wishing to implement an EO-PTC system carefully review the ConOps and safety analysis to ensure that safe operation is achievable with the systems and processes in use by that railroad. The railroad should review and modify the Implementation Plan as necessary to fit their individual needs.

BACKGROUND

The Rail Safety Improvement Act of 2008 (RSIA '08) mandates implementation of interoperable PTC on a significant portion of rail lines in the U.S. PTC, as defined in the RSIA '08, is a system designed to prevent train-to-train collisions, overspeed derailments, unauthorized incursions into established roadway work zones, and movement of a train through a mainline switch in the wrong position.



It is critical to the nation's economy and citizen safety to keep freight, passenger, and commuter traffic flowing. In some ways, today's PTC implementations counter these objectives because they can stop or slow trains prematurely or unnecessarily. These impacts can be due to exceptional events, such as equipment/system failures, premature warning or enforcement braking caused by conservative braking algorithm, incorrect data, and operator errors.

These events delay trains and reduce railroad capacity at a time when railroads are approaching capacity limits in many areas.

EO-PTC aims to increase operational efficiency by eliminating signal-based speed restrictions within blocks governed by Approach and Advance Approach indications (shown in Figure 1) when the PTC onboard is in the "Active" state.

OBJECTIVES

This project defined the concept, developed the safety case analysis, developed the implementation plan, and identified outstanding issues in deploying EO-PTC.

The objectives of this project were to:

- Identify the new functions, interfaces, and issues requiring resolution to implement EO-PTC. Emphasis was on those issues that required a safety analysis to resolve.
- Analyze options for retention or removal of wayside signals. Removal of wayside signals can lead to a reduction of wayside infrastructure and associated maintenance, while retaining the signals supports the more efficient movement of trains lacking operational PTC and non-vital PTC functionality.

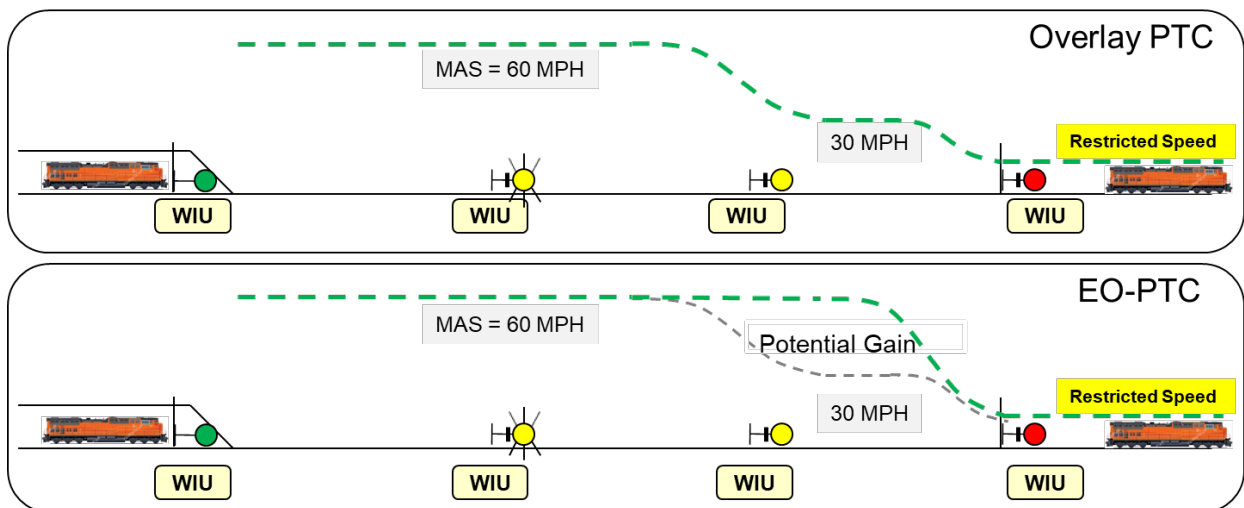


Figure 1. Speed limits with Overlay PTC and EO-PTC



- Develop a draft implementation and operation plan, and identify issues to be resolved.
- Develop incremental safety analysis needed to resolve identified issues.
- Determine any additional necessary safety assurance concepts.
- Revise the implementation and operation plan to address issues identified earlier to the extent possible.
- Develop operational concepts for failure and fallback modes of operation.
- Identify cost-drivers associated with implementing EO-PTC.
- Facilitate agreement among the stakeholder/advisory group (AG) and document any areas of special concern.

METHODS and RESULTS

To achieve the objectives of the project, TTCI completed the following tasks:

- 1. Develop Operational Concept.** TTCI surveyed the railroads to identify types of territories, scenarios, and train moves under which EO-PTC should be analyzed. TTCI leveraged information from other FRA projects that are being or have been executed by TTCI, such as the Higher Reliability and Capacity Train Control project, to identify failure modes. It also worked with the AG to understand normal and degraded state (fallback) operational scenarios. TTCI documented approaches for accommodating unequipped trains as well transitions between different train control mode territories.
- 2. Perform Safety Analysis.** TTCI developed a detailed safety analysis to identify any new or changed hazards, mitigations for those hazards, and the necessary rule changes associated with implementing EO-PTC. TTCI developed three hazard analyses: preliminary hazard

analysis, operating and support hazard analysis, and system hazard analysis. A safety analysis document comprising the results of the three analyses was also developed.

- 3. Develop Draft Implementation Plan.** TTCI developed a workable implementation plan based on the operational concept and safety analysis documents. TTCI also identified cost drivers associated with EO-PTC implementation. The results of this work were documented in the EO-PTC Implementation Plan.

CONCLUSIONS

The EO-PTC concept can be safely implemented at minimal cost with no changes to onboard hardware or software. Due to the manner in which wayside status codes are mapped by the onboard software, signals connected to a single WIU cannot be mapped individually, requiring changes to the WIU hardware configuration at territory boundary locations in order to map the last EO-PTC signal as a conventional signal.



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