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BEFORE THE

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

SUBCOMMITTEE ON RAILROADS, PIPELINES AND HAZARDOUS MATERIALS

OVERSIGHT OF PTC IMPLEMENTATION

SEPTEMBER 13, 2018

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On behalf of the Association of American Railroads (AAR), thank you for the opportunity to discuss positive train control (PTC). AAR members account for the vast majority of North American freight railroad mileage, employees, and revenue.

In this testimony, I will review the progress freight railroads have made in the development and implementation of PTC and what to expect going forward. My focus will be on Class I freight railroads and their PTC-related status.

The bottom line is that by December 31, 2018, all Class Is will have completed PTC hardware installation, trained all employees, and secured all needed radio bandwidth. Further, by the end of this year, PTC will be in operation on the vast majority — approximately 80 percent — of Class I PTC route-miles network wide, with some Class I railroads planning to be fully operational on their networks. Between 2018 and 2020, all Class I railroads will be completing PTC implementation, consistent with the statute. All railroads will continue their work on resolving technical operational challenges that will inevitably rise, which Congress anticipated and specifically provided flexibility for in its 2015 law. They also will be addressing the biggest remaining challenge of PTC implementation: interoperability with each other and with their tenant passenger and shortline railroads.

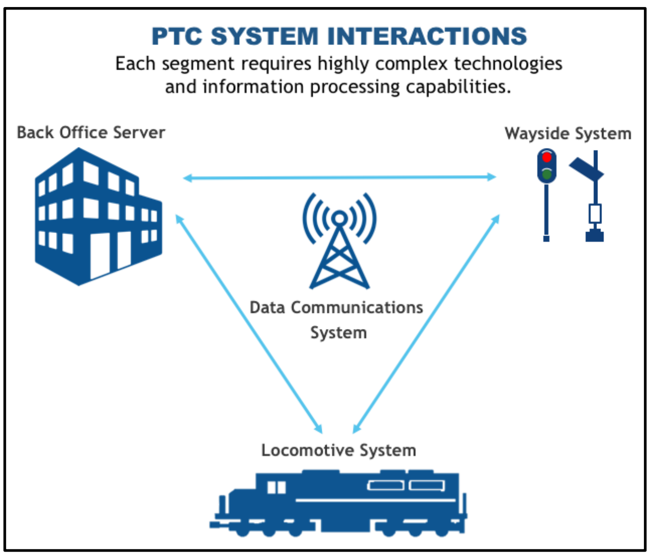
What is Positive Train Control?

As members of this committee know, "positive train control" (PTC) describes technologies designed to automatically stop a train before certain accidents caused by human error occur. Under the Rail Safety Improvement Act of 2008 (RSIA), passenger railroads and Class I freight railroads are required to install PTC on main lines used to transport passengers or toxic-by-inhalation (TIH) materials.

Specifically, PTC as mandated by the RSIA must be designed to prevent four major types of train accidents: train-to-train collisions; derailments caused by excessive speed; unauthorized incursions by trains onto sections of track where maintenance activities are taking place; and the movement of a train through a track switch left in the wrong position.[1] The PTC system now being installed to meet this statutory mandate is an overlay system, and meant to supplement, rather than replace, existing methods of operation.

To work as it should, a PTC system must be able to determine the precise location, direction, and speed of trains; warn train operators of potential problems; and take immediate action if the operator fails to act after a warning is provided by the PTC system. For example, if a train operator fails to begin stopping a train before a stop signal or slowing down for a speed-restricted area, the PTC system will override the operator and apply the brakes automatically before the train passes the stop signal or enters the speed-restricted area.

A PTC system consists of three main elements that are integrated by a fourth critical element, the wireless data communications system. An *onboard or locomotive system* monitors a train's position and speed and activates braking as necessary to enforce speed restrictions and unauthorized train movements; a *wayside system* monitors railroad track signals, switches, and track circuits to communicate data on this local



[1] A switch is the infrastructure that controls the path of trains where two sets of tracks diverge or converge.

infrastructure needed to permit the onboard system to authorize movement of a locomotive; and a *back office server* stores all information related to the rail network and trains operating across it (e.g., speed restrictions, movement authorities, train compositions, etc.) and transmits this information to individual locomotive onboard enforcement systems. Finally, all of these segments of the PTC system are integrated by a *wireless data communications system* that must move massive amounts of information back and forth between the back-office servers, the wayside equipment, and the locomotives' on-board computers.

Such a system requires highly complex technologies able to analyze and incorporate the huge number of variables that affect train operations. A simple example: the length of time it takes to stop a freight train depends on train speed, terrain, the weight and length of the train, the number and distribution of locomotives and loaded and empty freight cars on the train, and other factors. During the operation of a single train over a single operating segment of track known as a sub-division, the length of time and the distance needed to stop that train may change 100 or more times due to changes in the factors mentioned above. A PTC system must be able to take all of these factors into account automatically, reliably, accurately, and in real time in order to safely stop the train wherever it may be along its route.

PTC is an Unprecedented Technological Challenge

PTC development and implementation constitute an unprecedented technological challenge. Some of the development and installation tasks associated with the Class I railroads' efforts over the past few years include:

- ✓ A complete physical survey and highly precise geo-mapping of the approximately 54,000 route-miles on which PTC technology will be installed, including more than 450,000 field assets along the right-of-way (e.g., mileposts, curves, rail and highway grade crossings, switches, signals, track vertical profiles and horizontal geometry).

- ✓ Installing more than 28,000 custom-designed "wayside interface units" (WIU) that provide the mechanism for transmitting information from signal and switch locations along the right-of-way to locomotives and railroad facilities.
- ✓ Installing PTC technology on nearly 16,400 Class I locomotives[2].
- ✓ Installing PTC technology on nearly 2,100 switches in non-signaled territory and completing signal replacement projects, including upgrades to PTC-compatible signal technology, at some 14,500 locations.
- ✓ Developing, producing, and deploying a new radio system specifically designed for the massive data transmission requirements of PTC at tens of thousands of base stations and trackside locations, and on nearly 16,400 locomotives.
- ✓ Developing back office systems and upgrading and integrating dispatching software to incorporate the data and precision required for PTC systems.

In all these areas, Class I railroads have already made tremendous progress. Figure 2 has details on the status of Class I PTC installations at the end of July 2018.

FIGURE 2

CLASS I FREIGHT RAILROAD PTC INSTALLATION AS OF JULY 31, 2018

Locomotives			Wayside Interface Units		
Equipped and PTC Operable	Required for PTC Operation	% Complete	Installed	Required	% Complete
16,077	16,375	98.2%	27,857	28,083	99.2%
Employees			**Radio Towers**		
Trained	Require Training	% Complete	Installed	Required	% Complete
91,826	92,694	99.1%	14,895	14,928	99.8%

Source: AAR compilation of figures provided by individual Class I railroads

Additionally, as shown in Figure 3, at the end of July 2018, the Class I railroads already had in operation more than 37,000 route-miles, or nearly 70 percent, of the approximately 54,000 route-miles that will eventually be equipped with PTC. To be clear, each Class I railroad will

[2] As just one example of the magnitude of the PTC implementation effort, it takes about one person working for about one month to install all of the necessary PTC equipment on a single locomotive. It will take approximately 1,400 staff-years to install PTC on all of the Class I locomotives that require it.

FIGURE 3

CLASS I FREIGHT RAILROAD PTC IN OPERATION AS OF JULY 31, 2018

Miles		
In PTC Operation	Required for PTC Operation	% Complete
37,435	53,713	69.7%

Source: AAR compilation of figures provided individual Class I railroads

install 100 percent of PTC wayside, back office, and locomotive hardware, and complete all required employee training, by the end of 2018 and expect to have nearly 80 percent of required PTC route-miles operational by the end of 2018.

The AAR estimates that, as of today, freight railroads together have spent more than $10 billion — of their own funds, not taxpayer funds — on PTC development and deployment, and expect to spend more than $11 billion by the time PTC is fully operational nationwide. This does not include the hundreds of millions of additional dollars that will be needed each year to maintain the railroads' PTC systems once they are initially installed.

Testing and Validation is Essential for Safe Operation and Full Interoperability

From the outset, railroads' efforts were focused on development and testing of technology that could meet the requirements of the RSIA, particularly those related to interoperability, and that could be scaled to the huge requirements of a nationwide system. Essential software and hardware for many PTC components had to be developed and deployed, and then rigorously tested. Only after technology is actually installed and exposed to the rigors of day-to-day operations can the task of testing each of the individual parts, and the system as a whole, be completed under real world conditions.

This task is made particularly complex by the need to ensure that PTC systems are fully and seamlessly interoperable across all of the nation's major railroads. It is not unusual for one railroad's locomotives to operate on another railroad's tracks. When that happens, the "tenant" locomotives must be able to communicate with, and respond to conditions on, the "host" PTC system. Put another way, a CSX locomotive must behave like a Norfolk Southern locomotive when it is traveling on NS track; a BNSF locomotive must be compatible with Union Pacific's PTC system when it is on UP track; and so on. All the while, each railroad has its own operating rules designed to address specific conditions on its property, all consistent with FRA regulations, but further adding to this complexity. Ensuring this interoperability has been a significant challenge.

It is critical that any and all potential failure points be identified, isolated, and corrected. By necessity, a mature, well-functioning PTC system is enormously complex, and it is not realistic to think it will perform flawlessly day in and day out, especially upon initial implementation. That is precisely why testing, first in a simulated environment and then under real-world operating conditions, is so important. Unfortunately, the failure of a single part within a complex PTC system can mean that the system — designed to be fail safe — shuts down a train unexpectedly and unnecessarily. When that happens, it means that trains are not able to operate normally on affected rail lines until the failure is corrected, a situation railroads are facing today as they proceed toward PTC implementation.

Every day, as railroads finalize their PTC installation and expand PTC operations, the risk of accidents is lowered. However, as other train control systems implemented in other countries demonstrate, there is risk in improperly designed, installed, or operated PTC systems. This is not just a speculative concern. Since 2008, there have been a number of incidents worldwide in which accidents resulting in deaths and injuries occurred on rail lines that had PTC-like systems. These concerns make it essential that a railroad's first priority must be to implement PTC correctly, and to test and validate it thoroughly.

Conclusion

Railroads have devoted enormous human and financial resources to develop a functioning and reliable PTC system, and progress to date has been substantial. Class I railroads remain committed to safely implementing PTC as quickly as possible. By the end of 2018, each Class I railroad will have PTC fully operational or initiated revenue service demonstration on, at a minimum, 51 percent of its required PTC route-miles or subdivisions; have 100 percent of the necessary wayside, back office, and locomotive hardware installations completed; have all required spectrum in place; and have all required employee training completed.

In addition, network-wide approximately 80 percent of required PTC route-miles are expected to be operational by the end of 2018. While some Class I railroads plan to be fully operational by the end of this year, all Class I railroads will be fully implemented no later than 2020. In the meantime, Class I railroads will continue to work with each other and their tenant passenger and shortline railroad partners to successfully achieve full interoperability, which is the largest remaining challenge to a fully implemented national PTC system.