MARCH 2016 SYSTEM UPDATE

Developing and implementing a PTC system is a multi-part process requiring a networkwide approach. Union Pacific's PTC system consists of multiple technologies functioning together to constantly monitor and manage train movements. These technologies include thousands of components across the telecommunications spectrum, such as GPS, Wi-Fi, radios, antennas, satellites, base stations and first-of-its-kind software that taken together predict when to slow or stop a train.

Through January 1, 2016, Union Pacific:

- Invested $2 billion in PTC. Union Pacific's current estimate for PTC's total cost is about $2.9 billion.
- Installed 67 percent, or 14,166 miles, of total track miles with PTC hardware and software.
- Partially installed PTC hardware on about 81 percent of its 5,656 locomotives earmarked for the technology.
- Fully equipped 1022 locomotives with PTC hardware for revenue service demonstration (a test of the PTC system in a defined rail corridor).
- Installed 72 percent of the wayside antennas needed to support PTC along the company's right of way.

2018 DEADLINE

Union Pacific plans to implement PTC by the end of 2018. This plan assumes no major PTC component failures as the installation process continues. Union Pacific trains locomotive engineers to operate the PTC system roughly 60 days before PTC operations begin in a rail corridor. The company is using test data to refine the system and enhance the training process for locomotive engineers.

Union Pacific has documented to the Federal Railroad Administration the challenges in meeting the current regulatory deadline for full PTC implementation that could delay Union Pacific's PTC implementation plan, such as PTC component failures and PTC testing issues. Any delay in the plan would push Union Pacific's PTC system implementation past the 2018 deadline. Union Pacific's goal is to complete PTC system implementation by the end of 2018. With the unknowns of a new system comprising many unique technologies, software programs and hardware components, delays are possible.

WHAT IT DOES

☑ Automatically stops a train before certain accidents caused by human error occur, including train-to-train collisions, derailments caused by excessive train speed, unauthorized train entry into work zones or movements through misaligned track switches.

☒ Will not prevent vehicle-train accidents at railroad crossings, stop trains when pedestrians are on the tracks, or prevent incidents due to track or equipment malfunctions.

HOW IT WORKS

BRAKING IN PROGRESS

DISPATCHING CENTER

SIGNAL

PTC evaluates distance of train from signal

Warning given if engineer doesn't slow train

PTC triggers brakes if engineer doesn't brake

PTC IN CALIFORNIA

Since the 2008 federal mandate, Union Pacific committed to prioritize the Los Angeles Basin (L.A.) for PTC testing and deployment. PTC wayside equipment installation was completed in L.A. in 2014.

Union Pacific used a dedicated train to test PTC in the Santa Barbara area of the company's Los Angeles operating division over several months in 2014 and 2015. The test evaluated all aspects of the PTC system including wayside devices, radios, communication equipment, onboard systems and connectivity to the company's dispatching center in Omaha, Nebraska. With about 200 train trips, this test phase wrapped up in March 2015. PTC testing then launched in other rail corridors in L.A., including Union Pacific track in the Inland Empire.

Interoperability testing was done in coordination with MetroLink, Amtrak and BNSF Railway. PTC must be "interoperable" – passenger, commuter and freight trains must be able to seamlessly communicate and operate across all railroad systems. Any breakdown in interoperability presents unacceptable risks to the safety and efficiency of America's rail network.
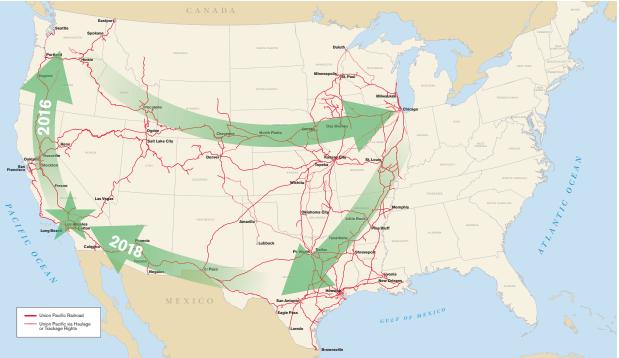
Once this phase of interoperability testing was complete, Union Pacific petitioned the FRA to certify its PTC system. The FRA must review each railroad's PTC safety plan and certify the PTC system after the system is developed and tested. This certification is mandatory before PTC-controlled trains can go into service.

PTC IMPLEMENTATION STRATEGY

Revenue service demonstration (RSD) began in Southern California December 28, 2015. Union Pacific is now working to expand RSD north along the West Coast of the U.S. The company will then implement RSD east in 2016, followed by implementation in the Chicago area in 2017. Upon completion of the Chicago RSD roll out, the company will implement RSD moving south of Illinois, reaching Union Pacific track in the Gulf of Mexico area. The last stage of the implementation plan takes RSD west from the Gulf of Mexico to Yuma, Arizona, by the 2018 deadline. Union Pacific plans to implement RSD in each region as PTC hardware and software installation is completed.

CYBERSECURITY

As Union Pacific moves forward with PTC implementation in 2016, the company is working in conjunction with the rail industry on cybersecurity investments and initiatives.

Current Union Pacific PTC implementation timing.