IS PTC GOING TO WORK?

With the positive train control deadline looming, here’s what we know about railroading’s biggest project in decades

by Steve Sweeney

A Union Pacific train splitting a signal on BNSF Railway tracks in California’s Cajon Pass has it all: a recently installed positive train control antenna and wayside unit; wayside PTC systems that would need to operate correctly with “foreign” power; and a remote location that shows off how GPS locating might be the most efficient way to find a train. (NAME: Steve Sweeney)
Tick, tock. U.S. railroads have collectively spent decades and billions of dollars on positive train control research.

Tick. Public outcry after a 2008 commuter crash that killed 25 people—a crash that a Federal safety panel says PTC could have prevented—pushed Congress to act.

Tock. With a Congressional deadline on their heels, railroads now have just 14 months to make PTC work nationwide.

Tick. And they say it can’t be done in time.

Tock. With that kind of time pressure you might think that U.S. railroads would have adopted technologies created for Amtrak’s Northeast Corridor or in the Midwest to fulfill their obligations.

And you might be wrong. Amtrak’s Class I railroads instead are quickening the pace of technology they’ve been working on since the 1980s. Rail executives say their chosen system is cheaper and has the best chance of helping their companies better manage trains, while reducing fuel and labor costs and meeting Congress’ safety mandate from the 2008 Rail Safety Improvement Act.

But to understand why Class I railroad leaders chose what they did, you first need to understand that PTC is a group of concepts, and little more.

“The PTC law is not a technical standard. There is no PTC system as such,” says Pierre-Damien Jourdain, solutions director for Alstom Signaling. In fact, several systems do quality under the safety law, including Siemens’ CBTC, GE Transportation’s Incremental Train Control System in operation on high-speed Amtrak lines in Michigan and Illinois, and Alstom’s Advanced Civil Speed Enforcement System. Amtrak and Alstom collaborated to create the system that has helped the passenger railroad successfully avoid crashes on the Northeast Corridor since 2000.

Among the alphabet soup of options, all PTC is, says Jourdain, another phrase for railroad control research. Officially, says cab signals (used in both Amtrak’s and GE’s systems) are absent from most freight locomotives and add another layer of complication and cost.

And then there is the conservative catch-phrase: “Go with what you know.” BNSF Railway and Pittsburgh-based Wabtec Corp. introduced an immediate forerunner of current GPS-based PTC systems known as the Electronic Train Management System in the 1990s. By the time of the 2008 safety act, the two companies were furthest along in the U.S. rail industry in deploying a PTC system on a freight railroad. Other Class I railroads had already joined BNSF and Wabtec to make nationwide implementation faster and less expensive.

WHAT I-ETMS WILL DO

Today, Wabtec offers I-ETMS, or Interoperable ETMS. Union Pacific, BNSF, CSX, Transportation, and Norfolk Southern have all said in interviews with Trains that they intend to use Wabtec’s system to comply with the safety law. The system shares features and is designed to be interoperable with other companies’ PTC applications but functions on Wabtec’s own software.

“Once of the other benefits we hope to achieve in leveraging this investment in PTC is integration with our other energy management systems to further improve our fuel efficiency,” says Chris Matthews, BNSF’s assistant vice president for network control systems. “As this gives us more precise location information for our trains, we’re incorporating that into our movement planning with the goal of increasing velocity.”

Through a spokesman, Wabtec confirmed that U.S. railroads will have “slightly different system configurations” but declined to elaborate on what options railroads will have available.

Based on the 2008 safety act’s definition of PTC, and previously published information, Wabtec systems will use GPS to locate a leading locomotive, and by extension, a whole train, along the track on the rail network.

Using that position information and local conditions reported by wayside units and dispatchers, computers built into locomotives will constantly recalibrate when a train must slow down and stop relative to wayside signals and digitized track warrants. The system will automatically apply the train brakes and cut engine power if the engineer fails to do so.

Train and back-office computers, meanwhile, maintain speed restriction information for curves, speed limits for operating through switches and crossovers, as well as variable information from train consists and track conditions, and local notices from maintenance-of-way crews. The capability prevents trains from running too fast for a given area, even if a train is operating at less than a local speed limit. And for misaligned turnouts, the system detects what position a switch is in, governing train movements more effectively than older track/circuit technology.

Wabtec’s system will comply with required event recording rules so every engine control, signal aspect, and piece of data used by the train crew and locomotive are stored in case of an accident.

Chicago is a sprawling railroad hub where passenger trains and toxic chemicals passing near millions of people warrant PTC installation. (Trains, Steve Swiney)

Conservatism is also the likely reason railroads didn’t adopt systems with cab signals. Officials say cab signals (used in both Alstom’s and GE’s systems) are absent from most freight locomotives and add another layer of complication and cost.

In certain forms, PTC systems cooperating with train management computer programs may make engine crews, as well as wayside and cab signals, redundant or obsolete.

In the face of several expensive options on how to communicate with trains and comply with the law, railroad officials chose to act conservatively.

This is why Class I didn’t consider the system Alstom developed for Amtrak. It uses fixed-location transponders embedded in the tracks to locate trains. In dense urban areas with hundreds of commuter trains a day and set track alignments, predictably spaced, hard-wired beacons could stay in place for years of service.

But in mountainous or remote areas of the country where trains are few and the population is sparse, the cost for frequently placed transponders, wiring, and corresponding maintenance would be great. Instead, railroads chose to anchor their system on the widely available global positioning system to locate engines.
Getting PTC right is hard

But what’s hardest to get right isn’t making trains safe or even making locomotive computers talk to other railroads’ networks. No, the hardest thing, rail industry experts say, is to just keep trains running.

Tom Schnautz, Norfolk Southern’s assistant vice president for research and advanced technology, helps explain why railroads are focused on reliability when he says that a positive train control system is designed to “fail safe.” In other words, a PTC system will stop a train by default when the railroad to see how components and systems function in the field.

Rather than installing multiple systems in locomotives, Schnautz says NS is testing “‘dual-equ” wayside units along the Northeast Corridor where NS freight and Amtrak passenger trains share the right-of-way for short stretches.

In much of the rest of the country, where GPS-based PTC systems are expected to dominate, the focus is on how systems will automatically work together without extra equipment. CSX Transportation’s PTC director, Kenneth Lewis, calls those tasks “communications” and “functional” interoperability. They are difficult to accomplish, Lewis says, because when PTC systems first came on the market, they weren’t interoperable at all. Rather than trying to squeeze the PTC systems to meet a new requirement, they were redesigned from scratch to accommodate the 2008 mandate.

“A CSX locomotive has to behave like an NS locomotive when it’s on NS property and vice versa,” Lewis says. “We all need to talk in the same message formats and use the same communications language and the same [radio] frequencies.”

Standards for the railroads’ systems to speak with one another are set by the Interoperable Train Control Committee, with the Association of American Railroads as a facilitator. Specific protocols are available from the AAR, for a fee, to public and to potential vendors.

A railroad executive says it was the committee that was able to overcome the challenge posed by “technical details” such as whether to put a computer function on a locomotive or in a wayside device, or elsewhere. It was also the committee that set standards for the medium of train-to-system communication.

PTC systems are designed to prevent head-on collisions like this one in Hobie, Ark., in August 2014. 

Trains usually operate on separate tracks, but occasionally something goes wrong. PTC systems must “know” when a track is aligned properly for a train movement. (National Railroad Passenger Corporation)
How many billion dollars?

Time is money. So for a moment, think of the time it will take for railroad laborers or outside contractors to install hardware and visual displays in 22,000 locomotives; the time it will take to install 38,000 new wayside systems that will cover the entire United States; or the time to install 12,000 signals in the nine states that currently don’t have a PTC system. It’s a huge undertaking for the company. “We are upgrading about 7,500 miles of our railroad this year,” says CSX’s Lewis. “There are a lot of people working hard to install this.”

It is easier then, to understand why U.S. railroads are spending $3.4 billion on PTC. It costs railroads nearly $17,452 per mile on PTC. UP spent the most, at more than $22,000 per mile, while CN’s Grand Trunk subsidiary spent more than $5,000 per mile.

The price of PTC will be $9.6 to $13.2 billion during 20 years. Mario Vazquez, Siemens, like Wabtec, Alstom, and other companies, is courting railroads and transit systems for future PTC spendings.

One railroad official told Trains that as PTC development has progressed, its company now expects PTC-equipped locomotives to be in shops for train control-related functionality or integration repairs 10 to 20 percent of the remainder of their working lives. That railroad is considering whether it needs to buy more freight locomotives to fill the downtime needs at a cost of more than $2 million a copy from U.S. locomotive builders.

Industry suppliers, meanwhile, see estimated costs as the potential for sales. Siemens AG, a relatively smaller player in the U.S. PTC market, announced in early August that it will hire 129 workers and triple its workforce in Pittsburgh to keep pace with a PTC contract for New York’s Metropolitan Transportation Authority.

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Commuters spend on PTC, too

A recent study by the Federal Transit Administration estimated that, by the time positive train control is installed and certified by America’s 25 commuter rail agencies, total expenses will likely exceed $2 billion. Unlike their freight rail brethren, commuter rail agencies depend, to a large extent, on public money for both operating funds and large-scale capital projects.

Funds for PTC must be diverted from other pressing needs, such as new or refurbished locomotives and cars, welded rail, and station improvements, to name but a few. Until recently, FTA and other federal agencies contributed little or no money to assist commuter rail with the cost of PTC. Even now, federal funding remains miniscule, even though the PTC requirement began as an unfunded federal mandate. In the case of Southern California’s Metrolink, federal funding is only about 9 percent of the total cost.

Metrolink operates on 388 route-miles, equipped with about 52 locomotives and 90 cab cars, all of which must be equipped with PTC gear and be totally interoperable with freight partners Union Pacific and BNSF, along with other area commuter rail agencies. In other parts of the country, the situation is similar.

The Metropolitan Transportation Authority, which operates the Long Island and Metro-North railroads, is expected to spend $428 million. In Chicago, Metra’s PTC costs are expected to come in at between $235 and $450 million, while Metrolink, the first commuter railroad to operate an approved PTC system after the 2008 Rail Safety Improvement Act, will spend $216 million, of which 50 percent will be paid by the five-county Southern California Regional Rail Authority, 41 percent by the state of California and only 9 percent by FTA. Seattle’s Sound Transit is expected to spend $53 million, including a cost-sharing split of about $5.3 million with BNSF Railway.

A cab display in service on Metrolink, which started using PTC in February.

MAINTENANCE, AND...

In decades to come, PTC systems will cost billions more to maintain and to update, just as signals, radios, and track do. In fact sheets, the Association of American Railroads says the projected cost to install first-generation PTC systems will be $8 billion.

The accountability office report to the Senate says the total costs for the industry will be $9.6 to $13.2 billion during 20 years. These numbers are based on FRA estimates and include non-AAR member shortline and regional railroads.

But those are the costs railroads expect.

It is no mistake: PTC will not be required (yet) on heavy-haul coal lines into Wyoming’s Powder River Basin. David Honan
Since the early years of railroad engineering, as soon as railways started to run more than one train at the same time on the same segment of track, the industry has sought various means and technologies to prevent trains from running into each other. Various "control systems" evolved over the decades; most were good, some not so good.

In the early 1980s, one idea for increasing safety land saving came from Richard Bressler, Burlington Northern's chairman and chief executive. He had a long career in the oil industry and became fascinated with new technology developed by the U.S. military; the global positioning system. He approved a team to look for a project using GPS and the vastly improved computer systems available by the mid-1980s.

That team's efforts proved the signal and communications pole line on a former Great Northern route extending west from the Lake Superior ports of Duluth, Minn., and Superior, Wis. originally. BN purchased with the Class 1 railroads to advance the train-control project, but eventually shouldered the responsibility alone for what became known as the Advanced Railroad Electronics, or AREIS. Information was provided to train crews via radio links to in-cab displays as well as to train dispatchers at the central offices. BN chose Rockwell International as the prime contractor for the radio system. AREIS became one of the first applications of GPS technology in the railroad industry, used to survey and produce accurate terrain profiles of the track. Locomotive displays included current train location, track profile, switch positions, and signal locations. AREIS was the first computer-aided attempt to calculate novelties (adjacents) breaking time and distance along with onboard brake override, particularly important to safely handling heavy trains in extreme weather conditions.

In the end, AREIS was not operated independently of existing control systems and it did not meet the price in affordable block signals could be removed. It was never "vitalized." In a 1991 observational study, Harvard Business School published the opinions and decisions of railroad leadership and why they didn't adopt AREIS, saying that executives were not fully comfortable with whether the assessment of AREIS benefits was realistic or optimistic." The report said executives struggled to find out if they could get some of the same benefits promised by AREIS with another technology, but came up short. In another follow-up brief in 1993, the business school said executives were still studying AREIS, but had made no decisions.

--- Forrest Van Schwartz

President Barack Obama's recently introduced GROW America Act includes language to grant FRA those powers, while otherwise leaving the Dec. 31, 2015, deadline intact. AAR has yet to take a public stance on this portion of the GROW America Act, but anonymous railroad officials told the Government Accountability Office for its 2013 report that piecemeal extensions amounts to unfunded penalties for railroads that meet the deadline without extensions or waivers. Though, in speaking about the deadline generally, the AAR says, "Our industry has been clear in stating that PTC will be done, but complete, nationwide interoperability cannot be accomplished by Dec. 31, 2015. Extending the deadline will allow railroads and other stakeholders, to make sure PTC is done right."

A FINAL THOUGHT

Positive train control, in its various forms, does work and will keep improving in the U.S.; it will be successful. Accordingly, even more than ever. The question is whether railways can move fast enough to satisfy Washington and the public. The report that railroad managers should grant FRA authority to hand out provisional certificates and grants by case; base deadlines to railroads that show "due diligence" in implementing PTC. President Barack Obama's recently introduced GROW America Act includes language to grant FRA those powers, while otherwise leaving the Dec. 31, 2015, deadline intact. AAR has yet to take a public stance on this portion of the GROW America Act, but anonymous railroad officials told the Government Accountability Office for its 2013 report that piecemeal extensions amounts to unfunded penalties for railroads that meet the deadline without extensions or waivers. Though, in speaking about the deadline generally, the AAR says, "Our industry has been clear in stating that PTC will be done, but complete, nationwide interoperability cannot be accomplished by Dec. 31, 2015. Extending the deadline will allow railroads and other stakeholders, to make sure PTC is done right."

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