How To Prevent America's Next Train Crash

Long-overdue rail upgrades could prevent the next big train catastrophe. So why are the railroads so reluctant to make them? *By Dan Baum Posted 01.17.2013 at 9:00 am*

A Big One When a Norfolk Southern train hauling chlorine through Graniteville, South Carolina, derailed in 2005, toxic gas poured into the town. AP Photo/Aiken County (S.C.) Sheriff's Department

The evening of January 5, 2005, was dry and cool in Graniteville, South Carolina. At 6:10, a 12-car Norfolk Southern freight train pulled up to the Avondale Mills textile plant, and Jim Thornton, a conductor with 18 years' experience, climbed down from the locomotive to open a switch and let the train roll onto a siding. It was getting close to the hour by which, according to law, the crew had to quit for the day and rest. After the workers had shut down the train, Thornton called a taxi to take him, the engineer, and the brakeman to a nearby motel. It never occurred to him that, for the first time in his life, he'd failed to check the position of a switch that he'd opened. All he thought, as the crew piled into the taxi was, "Lord, mission accomplished."

Seven hours later, a second Norfolk Southern freight train—two locomotives, 25 loaded cars, and 17 empties—approached Graniteville at 49 miles an hour. The engineer expected to pass through at full speed. Instead, the open switch shot him onto the siding. He saw the parked train and tried to stop, but it was hopeless. Both locomotives and the first 16 cars of his train derailed; the engineer was killed. Three of the cars contained chlorine, a common industrial chemical; one of them sheared open.

A dense white cloud of chlorine gas billowed through Graniteville. At 2:40 in the morning, police rousted 5,400 people from their beds and evacuated them. Eight more died; 72 sickened. The disaster helped push the Avondale Mills plant, which had been making cloth in Graniteville for 161 years, out of business. Four thousand people, some of them fifth-generation Avondale employees, lost their jobs. Seven years after the wreck, people in Graniteville are still sick.

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Trains carry 40 percent of America’s freight as well as 650 million passengers a year, and in general, their safety record is good and getting better. Most of the 2,000 accidents a year are minor. But when trains collide or derail, the results can be spectacularly ugly. Last June, two Union Pacific trains somehow ended up on the same Oklahoma track and collided head-on with such force that the locomotives almost fused. Three crewmembers died. Three weeks later, 17 cars of a 98-car Norfolk Southern train went off the rails in Columbus, Ohio, busting open three cars of denatured alcohol and igniting a fire that forced the evacuation of about 100 people. A CSX coal train jumped the track in Ellicott City, Maryland, in August; six of its 21 cars tumbled into a parking lot, killing two young women bystanders. In November, a Union Pacific train plowed into a Veterans Day parade float in Midland, Texas, killing four. Later that month, a CSX train derailed on a bridge near Philadelphia International Airport, tearing open a tanker filled with 25,000 gallons of vinyl chloride and sending 71 people to the hospital.

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Most worrisome are the 75,000 carloads of breathable poisons that trundle around the nation’s tracks every year at speeds of up to 50 miles an hour. The two most common are chlorine—the Graniteville chemical—and anhydrous ammonia, both of which can kill in particularly grisly ways if inhaled. Graniteville was the country’s worst rail accident involving breathable toxins, but there have been two others in the first decade of the 21st century: Minot, North Dakota, in 2002 (anhydrous ammonia; one dead), and Macdona, Texas, in 2004 (chlorine; three dead). At Minot, the problem was poorly inspected rails and inadequate tank-car construction, but at Macdona, the cause was as simple as at Graniteville: The engineer failed to notice a slow-down signal and blew past.
Could happen to anybody.

As bad as these accidents were, they could someday be remembered the way we recall the 1993 World Trade Center bombing—as a harbinger of worse to come. Imagine a railcar full of chlorine bursting on the CSX tracks less than a mile away from a big public event on the Capitol Mall in Washington, D.C.—an inauguration, say, or a concert. The resulting cloud could kill 100,000 people. Al Qaeda might do it, but it’s more likely that a $55,000-a-year engineer, in the 10th hour of his shift, would simply nod off at the controls. Human factors cause more than a third of all rail accidents.

Although the railroad keeps our 21st-century economy running, it’s essentially a 19th-century technology. Rail operators have known for decades that technological fixes could prevent rail disasters caused by the kind of human errors committed at Macdona and Graniteville, but they have been dragging their feet because those fixes are expensive and complicated. Congress is now making them get it done. But the railroads could also cheaply and humanely achieve big safety leaps simply by improving the working conditions of engineers—something they’re even less enthusiastic about doing.

The Aftermath: The chlorine released in the Graniteville crash killed nine people, sickened 72, and demonstrated the lethal potential of human error in the rail system. AP Photo/EPA

Forty years ago, the National Transportation Safety Board began urging railroads to design a way for a train to stop itself if the engineer "loses situational awareness"—that is, has a heart attack, falls asleep, gets distracted, or makes an all-too-human mistake. It wasn't like NTSB was asking railroads to find a cure for cancer. As early as the 1920s, the Santa Fe rail line between Kinsley and Dodge City, Kansas, used a rudimentary system to stop a train if it passed a red signal. In the mid-1980s, in the Minnesota iron range, Burlington Northern successfully operated the first GPS-based system to stop a train automatically if the engineer made a mistake; it dropped it within the decade, to save money.

Railroaders call such technology—systems that slow or stop a train without human intervention when the engineer makes a dangerous mistake—positive train control (PTC). The modern version requires the train to be "aware" both of what it is doing and what is happening on the tracks ahead, using a combination of data radios, GPS, and cellular networks. If a discrepancy arises—a switch is open that shouldn't be or the locomotive is passing a red signal—and the engineer doesn't respond, the system takes control of the train, applying the air-brakes and shutting down the locomotive.

In 1990, the NTSB put positive train control on its list of most-wanted transportation-safety improvements. The NTSB, though, has no regulatory authority, so the five U.S. Class I freight railroads—Burlington-Northern Santa Fe, CSX, Union Pacific, Norfolk Southern, and Kansas City Southern, all of which have annual operating revenues of hundreds of millions of dollars—simply ignored the agency. Only Amtrak responded, installing a type of positive train control on its Northeast Corridor trains in 2000 and a different version on some of its trains in the Midwest a year later. The Federal Railroad Administration, the railroads' regulator, had the power to make the Class I's fall in line behind Amtrak, but instead, the agency agreed with the Class I's: Positive train control was too expensive.

In 2007, Congress finally got involved, passing a law mandating positive train control, but President George W. Bush refused to sign it. Then came Chatsworth.

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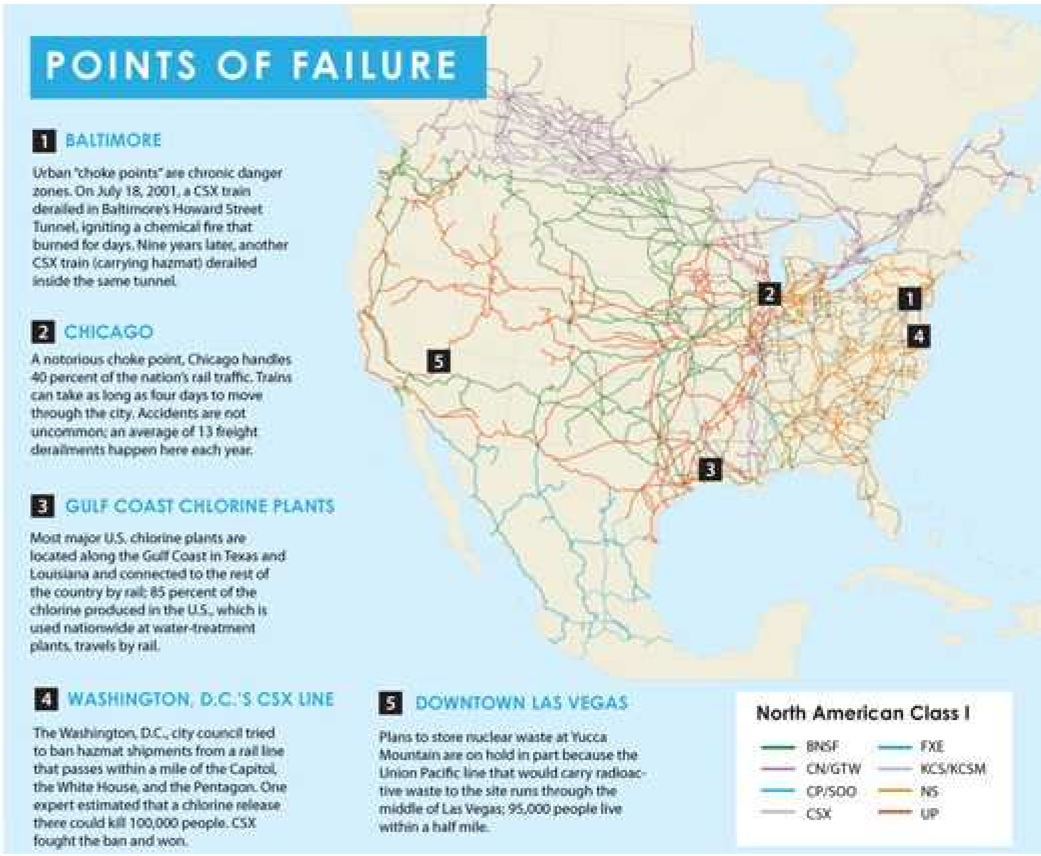
As a passenger-rail engineer, Robert Sanchez was, quite literally, a train wreck waiting to happen. Clinically obese, with high blood pressure, enlarged heart valves, diabetes, and HIV, he may also have had sleep apnea, which can leave sufferers perpetually sleep-deprived. To make matters worse, his work schedule at Metrolink, the commuter rail service for the Los Angeles basin, seemed designed to leave a man exhausted. Sanchez started at six in the morning, drove trains until 9:30 in the morning, then started again at two in the afternoon and worked until nine at night—a 15-hour split shift.

Yet the issue on September 12, 2008, was neither his health nor his exhaustion. As he drove his three-car train loaded with passengers west from Chatsworth, Sanchez was busy swapping text messages with a teenage train buff about the supercool world of locomotives—a huge violation of company policy. Four days before, he'd had this text exchange with the teenager, whom the NTSB calls "Person A":

Sanchez: Yea....but I'm REALLY looking forward to getting you in the cab and showing you how to run a locomotive.

Person A: Omg dude me too. Running a locomotive. Having all of that in the palms of my hands. Its a great feeling. And ill do it so good from all my practice on the simulator.
Sanchez: I'm gonna do all the radio talkin'...ur gonna run the locomotive & I'm gonna tell u how to do it.



Points of Failure : Click here to see this image larger. Paul Wooten

Later texts suggest that Sanchez had indeed illegally let the teenager operate the train—two days before the accident—with passengers aboard.

On the afternoon of September 12, in the last 69 minutes of his life, Sanchez exchanged 35 text messages with the teenager. Focused on his smartphone, he missed a red signal that should have held him back from a single track shared by freight lines. At 4:22 p.m., the engineer of a westbound Union Pacific train looked up and saw Sanchez's train coming at him at a combined speed of 80 miles an hour. The engineer hit his air brakes. Sanchez, texting until 22 seconds before impact, never touched his.

The collision drove Sanchez's locomotive 52 feet into the first passenger rail car, killing Sanchez and all 22 people in the car. Two more passengers also died; 101 were injured. On the freight train, the engineer, conductor, and brakeman somehow all survived.

Television crews arrived fast, and the Chatsworth crash became, for the issue of rail safety, what 9/11 was to aviation security. It escaped nobody's attention that had positive train control been in place at Chatsworth, Sanchez never would have reached the freight track; the system would have stopped his train at the red signal. Congress hastily revived the 2007 mandate and folded it into the Rail Safety Improvement Act of 2008, which flew through Congress in just 34 days. The president signed it late at night with no ceremony. The nation's railroads were given until 2015 to install positive train control on the 70,000 miles of track on which passengers or toxic-by-inhalation chemicals moved. In the emotional aftermath of Chatsworth, neither the railroads nor the Federal Railroad Administration objected.

That came later.

Graniteville's Wreckage : AP Photo/Environmental Protection Agency

If I lose my iPhone, Apple's Find My iPhone feature will pinpoint its location anywhere in the world within a few feet. Railroads, though, have only a very rough idea, at any given moment, of where their 18,000-ton freight trains are and what they're doing. Although each railroad operates vast control rooms that look like they belong on the set of Dr. Strangelove—with enormous electronic schematics of their tracks displayed across the walls—the information that controllers receive is amazingly crude.

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First, about half the nation's trackage is "dark territory," devoid of signals and invisible to controllers. Out there, it's 1850. Conductors operate by written instructions and their watches, stopping their trains and climbing down to open and close switches by throwing big iron bars. While it's true that the vast majority of freight traffic and all passenger traffic travels on tracks with signals, even there, controllers can't see their trains the way I can "see" my lost iPhone. They know only when a train has passed a given point—a switch or a signal that is wired into the grid. Those points are anywhere from one and a half to three miles apart, creating "blocks" of track. Controllers know when a train's locomotive has entered or left a block, but not how fast it's moving. They can talk to engineers by radio, but if they notice that a train has passed a red signal, all they can do is shout into the radio, and often they're too late even for that.

Positive train control, as conceived today, is intended not to replace control rooms and signals but to supplement them. The railroad farthest along in post-Chatsworth implementation is, not surprisingly, Metrolink, which lost 24 passengers and an engineer on September 12, 2008.

At six o'clock one recent morning, Darrell Maxey, who's in charge of building Metrolink's PTC system, picked me up at my hotel at the far eastern end of the L.A. basin and drove immediately to a doughnut shop. In his mid-fifties, with a bristle-gray moustache and glasses, Maxey exudes a Midwestern-style bemusement at the breathtaking convolutions of his job. He's an old railroader, a systems engineer by training, but installing positive train control at Metrolink is making him an IT guy as well. "This is the most complicated project I've ever worked on," he said. "Two, three hundred pages of documents at a time! For a guy who's made his career piecing railroad systems together, this is heaven."

We drove to Metrolink's maintenance yard, a sprawling, sun-blasted expanse of concrete where Maxey issued me a hard hat and reflective vest, hoisted himself aboard one of Metrolink's test trains' passenger cars, and ushered me up after him. Slumped on every seat and scattered across the floor were hefty sandbags, simulating the weight of a full load of passengers. We walked forward, and Maxey opened a door to the back of the locomotive. We threaded our way through the length of its interior, which felt like the engine room of a U-boat: hot, noisy, and diesel-pungent. We emerged into the sunlit engineer's cab, and Maxey motioned me into the engineer's seat.

Transforming railroads from a 19th- to a 21st-century mode of transportation means making the train itself responsible for its actions. Were I this train's engineer, I'd start my day by downloading into the train's onboard computer a program about that day's run: the weight and length of the train, as well as everything the system needs to know about the upcoming length of track, such as speed restrictions, grade, curves, signals, switches, and stops. If I were using track owned by other railroads, I'd download a separate program for each, because every railroad has its own way of signaling and communicating. Another download would alert me to temporary issues, such as workmen on the tracks. I could watch these downloads on an LCD screen mounted on the engine's dash; after that, I wouldn't have to look at the screen again, and, in fact, Metrolink is hoping I won't. It wants my eyes straight ahead.

As I start down the track, the onboard computer is constantly comparing the train's progress to the downloaded programs. Doing this means communicating wirelessly with every switch and signal along the way. If I fail to slow when I should or if the computer thinks I'm about to run a red signal, the system warns me. If I don't respond, it applies the air brakes and shuts down the train. It is designed never to let my locomotive pass a red signal, so it is constantly looking six miles—three signals—ahead. It measures the speed and weight of the train along with the steepness of the grade. A heavy train going downhill will get an earlier warning than a light train going uphill, but as a rule of thumb, it takes about a mile, or 90 seconds, to stop a three-car Metrolink train.

The onboard electronics that make positive train control work on Metrolink's test train are stuffed into a tiny compartment down in the nose of the locomotive, where, were this a freight train, the engineer's toilet might be. I peered in at an incomprehensible tangle of wires surrounding a rank of plastic and aluminum boxes: a cellular modem, data radios that communicate with signals and the control room, a train management computer containing the downloads, and a big orange "black box" that the NTSB looks for after a crash. It goes by the polite euphemism "event recorder."

For an industry that operates in much of the country as though it's in a western, this looked like a jump to Prometheus. We made our way back through the locomotive and stepped off, and Maxey pointed to the new adornments on the locomotive's roof. Up where a light and maybe a radio antenna used to sit, a forest of aerials sprouted: two 220MHz antennas for the data radios, two cellular antennas for redundancy, a GPS antenna, and the Wi-Fi antenna through which the train downloads its instructions prior to departure. “What all this is for, basically, is to make it impossible for you to speed or run a red light,” Maxey said. It sounded simple.

A Turning Point?: On September 12, 2008, a Metrolink commuter train collided with a Union Pacific freight train in Chatsworth, California, killing 24 people and injuring 101. AP Photo/Ryan Ling

To disabuse me of that notion, Maxey drove us to a wayside signal being outfitted for positive train control. Until now, such signals were nothing but big traffic lights—red, yellow, green—on steel posts. “Dumb” is the technical term; all they could do was change color. Maxey took a key from his pocket and unlocked the steel door on a small, windowless concrete shed that stood beside the signal. “Each of these has its own IP address now,” he said. “As the train goes along, it pings each signal, and if it doesn’t get a response, it shuts down the train because the unresponsive signal might be red.” He opened the shed door to a blast of cold air. “Got to be air-conditioned,” he said. “Some little switch houses are 170 degrees inside.” The shed was as stuffed with electronic gear as the nose of the train. “This all has to stand up to vibration, dirt, and rain,” Maxey said, and in case the air-conditioning fails, “it’s got to spec to 70 degrees Celsius, which is 158 Fahrenheit.”

Metrolink has 217 such wayside signals; modifying each one will cost $50,000. “The Class I’s have as many as 38,000 of these,” Maxey said, “which helps explain their lack of enthusiasm.”

Metrolink used to be an organization of railroaders—men accustomed to mechanical challenges wrought in iron. But with the move to positive train control, the railroad is acquiring a corps of IT types; they fill one of the biggest buildings I’ve ever seen. It’s an old General Dynamics cruise-missile factory a quarter-mile long that Metrolink slicked up with a big glass atrium, potted trees, and interior floor-to-ceiling windows. As Maxey walked me through, he kept buttonholing people and asking them to describe their résumés. I met electrical engineers, systems engineers, IT specialists, software developers. “See?” Maxey said. “See who we are here? This is the new face of railroading. Building the system is not the only challenge; it’s maintaining it for years to come. We’re just incredibly excited.”

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By “we,” Maxey meant Metrolink. Maxey and his colleagues are convinced that positive train control will put an end to the kind of engineer-caused disasters that occurred at Graniteville and Chatsworth. The major freight railroads, though, sound like 15-year-old boys being asked to mow the lawn.

The Class I’s knew better than to object when Congress was passing the law mandating positive train control in the wake of the Chatsworth wreck. Bellyaching at such an emotional moment would have looked insensitive. Not a single interest group took a position on the law as it was being debated in 2008. Three years later, though, when four Republican senators introduced a bill to delay the 2015 deadline for implementing positive train control, railroads suddenly became interested in congressional politics; they gave a total of almost $3.6 million to all but four members of the Senate, including $16,500 to Diane Feinstein and $47,800 to Barbara Boxer, two of the biggest proponents of positive train control when the original law was passed in 2008. Despite the shower of money, the bill to extend the deadline died without a vote, but that doesn’t mean the railroads have given up the fight. They’ll tell anybody who will listen that positive train control will cost too much, isn’t worth the money, places an undue burden on railroads and their customers, will make rail shipping less, instead of more, efficient, and is being forced upon them too quickly.

The Federal Railroad Administration says that building positive train control could end up costing $10 billion. Even at a time when the Class I’s are doing well—profit margins ran from 17 to 45 percent last year—$10 billion is a lot of money, roughly equal to everything the railroad industry spent on buildings and equipment in 2010. Maintaining the intricate system will cost the industry an additional $850 million a year.

For that, the railroads will get a system that would have prevented the marquee Chatsworth, Red Oak, and Graniteville wrecks but would do nothing to prevent 98 percent of train accidents, including the types that cause the most deaths: knuckleheads walking on tracks or trying to zip across road crossings ahead of speeding trains.

Chatsworth Collision: The disaster prompted the federal government to require railroads to install positive train control systems—which could have prevented the crash—on 70,000 miles of track nationwide. AP Photo/Reed Saxon

And even that 2 percent of collisions will be prevented only if the system works well. The GPS used in positive train control doesn't work in tunnels or urban canyons. And the cellular backup will have to have a reliability rate of one failure in every hundred million tries. "Compare that to dropped cellphone calls," says George Bibel, author of Train Wreck: The Forensics of Rail Disasters.

The industry is going to have to acquire 58,000 digital radios of a type never built before, and because trains travel on other railroads' tracks, each radio must be able to communicate with those of every other railroad. Several railroads, particularly in big cities, are having trouble getting enough bandwidth in the crowded radio spectrum to launch the system. Ask a railroader to describe the technical challenges of implementing positive train control, and you can expect to listen for a while.

In 1977, Mother Jones magazine broke the story that the Ford Motor Company had concluded, when its Pinto was blowing up with frightening regularity, that it was cheaper to pay the widows and orphans than it was to recall the cars and fix the problem. That cold-blooded cost-benefit analysis caused a scandal. Yet for the past three decades, since President Ronald Reagan ordered cabinet departments and independent agencies to conduct cost-benefit analyses before issuing new regulations, such computations have been national policy.

In the case of positive train control, the Federal Railroad Administration needed to weigh the benefits of avoiding the tiny category of accidents that the system would prevent against the projected costs. Totaling up the cost of wrecked equipment was fairly easy—and so, it turns out, was computing the value of the human lives that positive train control would save. The Federal Railroad Administration's parent agency, the Department of Transportation, had already done the math, concluding in 2008 that "the best present estimate of the economic value of preventing a human fatality is $5.8 million."

When the Federal Railroad Administration counted the average seven annual deaths and 22 injuries positive train control would prevent in a year and added the cost of the property damage and evacuations that positive train control would obviate, it concluded that positive train control would save the industry just $90 million a year. That's just a tenth of the system's annual maintenance costs, and a wretched cost-benefit prospect—unless you or somebody you love is one of the seven people saved.

Every freight railroad to which I spoke, as well as the industry group the Association of American Railroads, inveighed against being forced to implement positive train control, especially by the end of 2015. Some even claim it will make their lines less safe. In an e-mail, Kansas City Southern warned me darkly: "The inflexibility of the statutory mandate and its deadline is likely to result in previously unforeseen operating consequences if not modified"; Union Pacific told me it would rather spend the money on "proven safety alternatives"; and Luther Diggs of Philadelphia's commuter line SEPTA told the local Inquirer, "We won't have one bridge or substation or station until we get this paid for. It just means we don't do a lot of other things." In other words, if a train rolls off a poorly maintained track, blame Congress for rushing the railroads to implement positive train control.

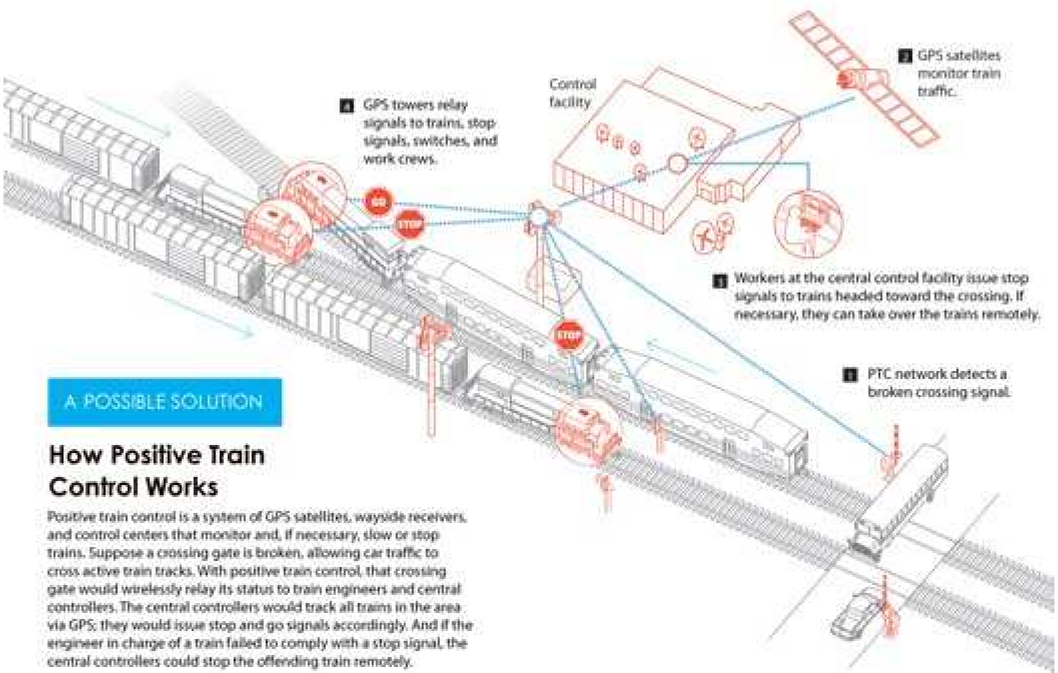
But it's hard to sympathize with the railroads. The 2 percent of accidents that PTC could prevent includes the most catastrophic possibilities—the black-swan big ones, like tankers of chlorine bursting open within a mile of the National Mall. Call it the tyranny of technology in a litigious age: If a technological fix that may save lives is available, you're pretty well obliged to apply it.

The Way Forward: Metrolink is on schedule to beat the 2015 deadline for installing positive train control. Now the question is: Will the Class I freight railroads follow along? Ciro Cesar/LA Opinion

Of course, there also exists a very cheap way to help prevent train crashes: Let engineers sleep. The Federal Railroad Administration sets limits on how many consecutive hours an engineer can work but nonetheless lets railroads treat freight engineers, in the words of one, "like plug-in flashlights." Engineers never know exactly when they're going to be called to work, so they never know when they should sleep. A 56-year-old Midwestern engineer for a Class I, who asked me to withhold his name because he would be fired for talking to a reporter, described a typical, Catch-22 dialogue with his employer: "'When do you want me to work?' 'I don't know; I'll call you.' 'Okay, should I go to bed now or stay up and watch TV?' 'That's up to you; but I want you to be rested.' "

"You never know when you're going to get a day off," he told me. "There's no lunch break. You have to eat at the controls. If you have to go to the bathroom, you wait until you're going up a long hill and you know the train isn't going to run away, and you open the back door and you pee off the walkway. You're in a mode where you're at 20 percent of your abilities. I've been dreaming at the switch."

He and his union—the [Brotherhood of Locomotive Engineers]—have mixed feelings about positive train control, though, because they worry that it could make it easier for Class I freight lines to further reduce the size of a train's crew. "In 1974, we had five guys on a crew: fireman, head brakeman, an engineer in the cab, and, in the caboose, a conductor and a rear brakeman," he said. "Now we have two": an engineer and a conductor in the cab. What positive train control will do, he fears, is "eliminate the conductor. If we have this PTC, there's no reason we can't run a train with one man."



A Possible Solution: Click here to see this image larger. Trevor Johnston

Much as they revile the 2015 deadline for implementing positive train control, neither the individual railroads, the Association of American Railroads, nor the Federal Railroad Administration want to discuss adjusting working conditions as a means of improving safety. "You're going down a whole path that is about labor negotiations and not about PTC," said Union Pacific's Jeff Young. "That's not what I'm here to talk about."

In general, companies would much rather buy equipment than meddle with their employees' working conditions. Capital investment is deductible, predictable, and finite. Start making concessions to employees, and it can go anywhere—and the company will be living with the changes forever. For its part, Congress would much rather order companies to buy stuff than to poke its nose into employee relations. Every dollar the railroads spend on positive train control boosts the economy.

The Association sidestepped the issue of unpredictable sleep schedules in a written response, saying only that positive train control "was never intended to solve the problem of a locomotive engineer falling asleep," an odd comment, as that is a big part of what it is intended to do. "The individual employee is responsible for managing their personal sleep and rest habits within the federally mandated rest periods." In other words, if engineers are sleepy, blame them.

The Federal Railroad Administration says it lacks the authority to order railroads to give engineers regular hours (the way things are done, say, in Britain). Only Congress can do that, the FRA's communication director Kevin Thompson told me. What the agency does in the meantime, Thompson said, is offer engineers "a website with techniques and tips to better manage their sleep issues."

Now that they've tried and failed to get Congress to push back the 2015 deadline, the railroads are grudgingly committing to it. "You can argue it so long," said Patti Reilly of the Association of American Railroads. "At a certain point, we want to do it, we want to do it well, and we want to do it so it doesn't negatively affect our operation." But by now they've spent so long fighting the 2015 deadline that it's hard to see how they'll meet it. Beyond 2015? Between the railroads' institutional resistance and the technical challenges they face, don't hold your breath.

On the other hand, given the lethality of the chemicals trundling around the nation's rail lines 24/7 and the exhausted state of the engineers hauling them, maybe you should.

Dan Baum's book Gun Guys: A Road Trip comes out in March. He lives in Boulder, Colorado. This article originally appeared in the February 2013 issue of the magazine.

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