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Reducing Passenger Train Procurement Costs

The FRA's Outmoded Safety Regulations Should Be Repealed

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Interest in passenger rail around the United States has increased in recent years. With their ability to bypass congested freeways and crawling city streets, new passenger rail lines on existing rights-of-way is one way to offer mass transit in metropolitan areas. Yet even if the physical infrastructure is largely in place, the high cost and low performance of trains made to suit American regulations has stifled innovation in this sector and needlessly increased costs.

If passenger trains are ever to attract ridership and become a viable part of the country's transportation mix again, it is vital that operators have access to the best practices and the best, most cost effective trains available. Yet presently, American passenger railways are forbidden from purchasing trains in the most cost-effective manner possible. The Federal Railroad Administration (FRA) has strict crash safety regulations for passenger railcars which trains in Europe—where passenger rail is well established and remarkably safe—do not have to meet. In order for railcars compatible with European regulations to meet FRA rules, they need to add significant bulk and weight, thus adding to both their manufacturing and operating costs.

The objective of crash safety is to ensure that passengers and train staff are not injured or killed in a crash. Passengers can be injured a number of ways: by being crushed as the train car collapses, in fire, or from trauma due to hitting an object inside the train like a table or seat. The specifications designed to prevent the car from collapsing and crushing people address a railcar's *crashworthiness* and *occupied volume integrity*.

A direct regulation-to-regulation comparison is impossible, given the different safety philosophies of the International Union of Railways (UIC), to which European rules conform, and the FRA. Despite the cost imposed by the FRA on America's passenger train systems, research into crashworthiness rules by the agency shows that they are less safe than European-style crash energy management technology.[1] A heavier train takes longer to decelerate, which makes crashes more likely to occur. A reform of the rules, then, will be of exceptional

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importance not just for the sake of transportation authorities but also for the sake of passengers who will be involved in a crash.

Maintaining Passenger Car Integrity. The FRA requires the undercarriage of a train to withstand 800,000 lbs. of force without permanent deformation, the idea being that a train should be able to rigidly resist the impact of another train. This aim is regulated by the FRA under 49 CFR 238.203 and is often said to deal with buff strength.

Buff strength requirements as we know them date back to 1912. The U.S. Postal Service had been using baggage cars as mail cars. To save time, employees would sort mail as the train ran its route. Unfortunately, the baggage cars offered little protection in a crash, and employees were often injured or killed. In 1912, the Railway Mail Service Specification was published to address this problem. It required the undercarriage of postal cars to be able to resist 400,000 lbs. of force without permanent damage, later increased to 800,000 lbs. at the recommendation of the Association of American Railroads in 1939 and made standard in 1945.[2]

In 1956, the specification became law for new multiple-unit trains. Unlike traditional trains, where unpowered cars are pulled by a single locomotive, multiple units have their power supply distributed between each of the vehicles. Then in 1999, the Federal Railroad Administration required all intercity passenger and commuter rail equipment to meet this specification.[3]

While simple, the specification's straightforwardness gave it legitimacy. It is easy to define and easy to see if a railcar is compliant. If the car has permanent damage after a crash—like stress fractures or crumpling—it does not pass the safety measure. Since the introduction of this buff strength requirement, other crashworthiness regulations have been built with buff strength in mind. Corner posts, for example, which protect the car against crashes into the front or rear wall of a rail car, are only as strong as the undercarriage to which they are attached.[4]

European regulators take the opposite tack of the FRA. Rather than rigidly resist a crash, Europeans design trains to gracefully deform in a controlled manner under the UIC design standard EN 15227.[5] Under this approach, known as crash-energy management (CEM), crumple zones are designed to absorb the energy of a crash. These zones are typically in spaces where people probably would not be during a crash, such as electrical closets and passageways between railcars.

This does not mean buff strength rules are absent from European regulations, only that they are not as strict as those imposed by the FRA. To allow the crumple zones to crush before the occupied areas, the occupied volume needs to be strong enough to withstand some of the crash energy. Buff strength in European trains is 337,200 lbs. of force.[6]

Maintaining the Integrity of the Engineer's Seat. The FRA requires that the end of a train have the resistive strength of a half-inch plate of steel. This, similar to buff strength, is designed to allow a train to rigidly resist a crash. It is regulated under 49 CFR 238.209.

This kind of resistance is absent in European systems, which emphasize energy absorption rather than energy resistance. The front of a train is designed to crumple gracefully, absorbing the energy of a crash in a similar fashion to the front of an automobile. If a train does crash, the crushed area of the train can be easily removed and replaced.[7]

Preventing Trains from Telescoping. During a crash, there is a chance one car will telescope and mount the other. This occurred on Washington's Metro system in 2009 and is an exceptionally deadly situation called train override.[8]

The FRA requires what is known as an anti-climbing mechanism to prevent this kind of uplift under 49 CFR 238.205. A single mechanism must prevent 100,000 lbs. of uplift, a requirement that is impossible for CEM technology to meet.[9]

European design inherently prevents override, in some ways better than the FRA's requirement. An override is an uncontrolled collision where the front car absorbs the vast majority of the energy in a crash. By distributing the energy of a crash along the entire length of a train, CEM prevents any one car from absorbing all the energy and prevents the override from occurring.[10] In addition, when the front of a CEM-designed train collides with another train, the front crumple zone deforms into the shape of the opposing train, locking them together and preventing override. None of these are single mechanisms, and so are not compliant with 49 CFR 238.205.[11]

FRA regulations are in effect on any track connected to the U.S. national rail network. As transit agencies try to invest in service along existing track, they bump up against crashworthiness rules that are fundamentally opposed to European regulations, limiting the kinds of trains they can buy. Rather than purchase off-the-shelf trains that have run safely in Europe for years, transit agencies need to purchase trains that are either heavily modified to fit regulations, as Amtrak did with Acela in 1998, or design entirely new trains, as California's Sonoma-Marin Area Rail Transit District (SMART) system did with its trains in 2010.

Unfortunately, the results often are not good. A FRA-compliant railcar is heavier than its European counterpart. This means that performance suffers, just as it would for a steel bicycle or an armored Humvee. Since the demand for compliant railcars is fairly low, the price is high. The end result is an underperforming, overpriced piece of equipment.

The Diesel Multiple Unit. Most new train systems in the United States use multiple-unit systems that allow trains to be as short or as long as needed to fit the projected ridership. A common type of multiple-unit train is the electrical multiple unit (EMU), used in subway systems like New York's MTA, Washington's Metro, and San Francisco's BART. Outside the U.S., EMUs are also used for high-speed travel. Japan's Shinkansen and France's TGV, for example, use EMUs.[12]

Diesel multiple units (DMUs) operate in a similar manner to EMUs, but run on diesel rather than electricity. In the United States, where electrified tracks were never widespread, DMUs offer a way to create a new service with minimal investment in new infrastructure. In Europe, DMUs also mean cheap vehicles. The DMU version of Stadler Rail Company's FLIRT costs about $2 million per unit,[13] while the EMU version costs approximately $3 million per unit.[14] This is predictably not the case in the United States, as the experience of California's SMART shows.

Sonoma-Marin Area Rail Transit (SMART). In 2009, when SMART officials began to consider what sort of vehicle to purchase, they knew they would be required to comply with FRA regulations. Their railroad was contractually obligated to run freight for most of its length, and so they had the option of applying for a waiver from crashworthiness restrictions or to purchase vehicles that could meet the restrictions.[15]

Rather than risk delays due to a rejected waiver, SMART officials opted late in 2009 to create a brand new train specifically meeting their requirements. The least expensive option came from a coalition of the Japanese firms Suitomo and Nippon-Sharyo.[16] The new train car would have similar operating capacity to Stadler's FLIRT, but cost over 50 percent more at $3.3 million per unit.[17]

The problem extends beyond cost. By commissioning new trains that would be unique to the SMART system, the district opened itself up to a potential lemon. These will not have the extensive operational history that existing DMU vehicles have. Moreover, parts will become difficult to come by if the manufacturer decides to cease production.

This is not an idle concern. Amtrak's Acela train, which was also custom-built, experienced exactly the problems SMART risks with their new vehicle.

Acela. In the 1960s, as high-speed rail began to take hold in Europe and Japan, the United States government became concerned that it would be left behind. In response, Congress passed the High Speed Ground Transportation Act of 1965, establishing the Office of High Speed Ground Transportation and appropriating $90 million to research high-speed rail.[18]

One of the first projects it funded was a series of U.S. Department of Transportation (USDOT) tests, including one involving a jet-powered train, to determine whether America's aging tracks could handle higher speeds. With a positive result, a partnership of USDOT, Westinghouse, the Budd Company, and the Pennsylvania Railroad developed the Metroliner, an EMU train designed to serve the Northeast Corridor (NEC) and began running in 1969.[19]

Unfortunately, while the Metroliner enjoyed some modest success, it was not an ideal solution for the NEC. Its top speed, just 125 miles per hour, was well below that of the foreign systems that inspired it. And the NEC's twisting, 19th century track meant trains had to slow around each curve, and so Metroliner's average speed was even lower than that.[20]

In 1992, Amtrak launched an initiative to develop a faster, tilting train specifically for the NEC. To gather data, it invited two European train manufacturers, Sweden's Kalmar Vekstad and Germany's Siemens, to carry passengers along the corridor.[21]

The two trains—Kalmar Vekstad's X2000 and Siemens' ICE—were more than able to handle the NEC,[22, 23] but Amtrak and the FRA put out a bid for a new train design to meet the needs of the system.[24] In the end, a consortium of Alstom and Bombardier won the bid over Siemens, with the help of more than $600 million in Canadian financing. Their design would be based on Alstom's TGV but adapted to comply with U.S. regulations.[25]

In 1998, two years into the design, the FRA released the crash regulations outlined above, which threw the project into disarray by requiring a dramatically different design. Then-Amtrak President Thomas Downs said the FRA turned Acela railcars into "rolling bank vaults."[26] Engineers began referring to their project as *le cochon*—"the pig."[27]

The end result was something akin to Frankenstein's monster. To meet buff strength requirements, Acela railcars weigh twice as much as comparable European models.[28] The extra tonnage wreaked havoc on rail infrastructure built for lighter railcars. In 2002, cracks developed in the suspension system that could have caused derailment, and Acela service was partially pulled from the NEC. In 2005, dangerously large cracks were discovered in the braking system, and Acela was again pulled from service.[29]

Today, the Acela faces frequent breakdowns and expensive maintenance. Indeed, the relative success of the service, at least when compared to Amtrak as a whole, has occurred in spite of, not because of its vehicles. The lighter X2000 ran from Washington, D.C., to New York in two hours, 15 minutes,[30] while the shortest regular run on Acela is two hours, 45 minutes.[31]

Reforming the Rules. The FRA could easily address this problem by adopting European design standards. This would give U.S. transit agencies access to a vast array of more affordable and effective vehicles. Unfortunately, however, the FRA appears unlikely to take this step.

In response to an interview with urban policy writer Stephen Smith, FRA officials described the heavier freight trains and trucks in the American market as characteristic of their approach to safety regulations being "more stringent" than those in Europe or Japan.[32] Yet, the weight of the freight train and freight truck impacted does not matter in the realm of crashworthiness. What matters is whether the passenger train can absorb the energy of the crash, and the evidence shows that trains compliant with European rules can.

When hitting a 10,000-ton freight train, the impetus will be on whether the far lighter passenger train will be able to absorb the energy of its own momentum and begin to move with the freight train's forward momentum. It is like hitting a wall and then a bit more.

In such a circumstance, the risk is quite high for the front car to telescope. Indeed, during tests, FRA-compliant trains did telescope when striking a freight locomotive.[33] This did not occur with a train outfitted with CEM technology, and the two trains actually began to move together.[34] Tests have also shown that, when hitting a 40-ton truck, the highest legally allowed on the Interstate Highway System, European trains perform equally well.[35]

If the FRA insists that the operational environment of the Untied States is uniquely dangerous, it should overhaul its regulatory mandates and take a step back from the prescriptive rules currently in place. Instead, it should create a series of performance metrics that would allow train designers to innovate. It now asks, "Does this train fit our rules?" It should ask, "Is this train survivable in a crash?"

This would allow U.S. transit authorities to purchase not only European trains, but also Japanese trains, which are designed to different effective standards. The United States could be a melting pot of train designs from around the world.

The FRA should also move beyond crash survival and start to focus on crash prevention. Positive train control, which can significantly reduce the incidence of crashes, is an important piece in this puzzle, but the FRA does not take stopping distance into account when evaluating a train's safety.[36] This would have bearing on the train's weight and, therefore, the buff strength rules.

In addition, the FRA does not take into account a given train system holistically when examining the crashworthiness requirements of the system's vehicles. If the system is connected to the national train network, it is subject to the same crashworthiness rules as any other system. The Long Island Railroad, for example, must run fully FRA-compliant trains despite the fact that they will not encounter heavy freight on its tracks.[37]

Conclusion. The FRA has imposed a heavy burden on American passenger railroads. By mandating crashworthiness requirements fundamentally opposed to crashworthiness standards that have proven effective in Europe for years, the FRA has raised a large trade barrier between the EU and the United States passenger railway markets. The argument that these rules are necessary to ensure passenger safety has been shown by the FRA itself to be invalid.

The requirements force Amtrak and transit authorities across the country to purchase custom-made trains that are unnecessarily expensive, underperform, and do not meet the best safety practices of the rest of the world. Any American company founded to meet that demand will find itself unable to export its products to other countries with more modern safety standards, further hindering its opportunities for growth.

Interest in passenger rail in the United States is growing. Unfortunately, under the current safety regime, any operator will be at a disadvantage in the transportation market without any appreciable gain in service or safety. These rules must be reexamined and reformed.

Notes

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