



U.S. Department  
of Transportation

**Federal Transit  
Administration**

Office of Transit Safety and Oversight  
Washington, DC

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# SA-22-2

## Safety Advisory

10/13/2022

### **Subject: Signal System Safety and Train Control**

**Purpose:** The Federal Transit Administration (FTA) issues Safety Advisory 22-2 (SA 22-2) to recommend that State Safety Oversight Agencies (SSOAs) direct Rail Transit Agencies (RTAs) who operate Rail Fixed Guideway Public Transportation Systems in their jurisdictions to consider signal system safety and train control as part of the RTA's Safety Risk Management (SRM) process. In addition, FTA advises SSOAs to incorporate SA 22-2 into their oversight activities.

**Background:** Signal systems and train control systems control and monitor the movement of trains. They can be used to locate and maintain safe separation between trains and can control speeds and movements. RTAs deploy different designs and technologies based on their respective system configurations, vehicle selection, available funding, and self-defined system performance requirements. For example, some RTAs do not use formal signal systems, relying instead on operator compliance with traffic signals, and others use sophisticated signal system technology that can automatically control train movements. While FTA has not issued minimum safety standards governing the use of signal systems in the transit industry,<sup>1</sup> the American Public Transportation Association (APTA) developed and issued a series of voluntary safety standards and recommended practices to support these activities.

Signal system safety and train control are top safety priorities for FTA. A variety of inputs and data sources have indicated that Federal action is needed to ensure safety within the transit industry:

- **National Transportation Safety Board (NTSB):** In 2009, the NTSB issued recommendation R-09-008 to FTA after a Massachusetts Bay Transportation Authority (MBTA) train rear-ended another MBTA train that was stopped at a red signal. The NTSB recommended that FTA “facilitate the development and implementation of

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<sup>1</sup> Commuter railroads and some RTAs with shared-use waivers from the Federal Railroad Administration (FRA) must comply with 49 CFR part 236, which governs the installation, inspection, maintenance, and repair of signal and train control systems, devices, and appliances. RTAs that are not subject to FRA's jurisdiction may determine their own system testing and maintenance standards, though many transit agencies adopt elements of part 236 to design, operate, inspect, and maintain signal systems.

positive train control systems for rail transit systems nationwide.” In 2015, the NTSB issued R-15-022, which superseded R-09-008, to FTA after a Chicago Transit Authority train collided with a bumping post at O’Hare Station. The NTSB recommended that FTA “require rail transit agencies to implement transmission-based train control systems that prevent train collisions.” The NTSB reiterated R-15-022 in its April 2022 accident investigation report on a collision between two Sacramento Regional Transit trains in 2019.

- **FTA Safety Risk Management:** FTA assessed signal system safety and train control hazards and evaluated the safety risk of potential consequences for the entire industry through its SRM process. Specifically, FTA identified four key hazards and nine potential consequences focusing on maintenance of wayside and vehicle signal system components, signal system design, and use of signal system technology.
- **Request for Information (RFI):** On February 6, 2019, FTA issued an RFI to SSOAs to inventory hazards, incidents, and safety risks related to train control systems in the rail transit industry. Nationwide, 38 RTAs operate 42 rail transit lines with at least one form of train control system, including Automatic Train Control and Automatic Block System.
- **Transit Advisory Committee for Safety (TRACS):** TRACS, FTA’s Federal advisory committee on transit safety matters, highlighted the benefits of signal systems and train control systems in its reports on roadway worker protection and trespass and suicide prevention. TRACS also discussed the importance of signal system expertise for SSOAs to conduct sufficient oversight.

**Recommended Action:** FTA recommends that SSOAs direct RTAs within their jurisdictions to consider signal system safety and train control as part of the RTA’s SRM process within 30 days of the date of this Safety Advisory. In accordance with 49 CFR § 673.25, a transit agency must develop and implement an SRM process for all elements of its public transportation system. The SRM process must comprise the following activities: safety hazard identification, safety risk assessment, and safety risk mitigation. Pursuant to 49 CFR § 673.25(b)(2), a transit agency must consider, as a source for hazard identification, data and information provided by an oversight authority and FTA. FTA recommends that SSOAs direct RTAs to, at a minimum, consider the hazards identified in Table 1 as a source of information in their safety risk assessments. At locations where signal systems are not presently installed, RTAs should consider whether safety hazards and risks exist in the absence of signal system installations and whether mitigations may be necessary. FTA further recommends that the SSOAs obtain completed risk assessments and any associated safety risk mitigations from the RTAs within 180 days of issuance of this Safety Advisory.

FTA further recommends that SSOAs review the signal system safety and train control SRM activities performed by RTAs and confirm that each RTA in their jurisdiction has adequately addressed hazards and potential consequences.

**Table 1: Hazards and Potential Consequences**

<b>Hazard</b>	<b>Description</b>	<b>Potential Consequence</b>
1. Wayside signal components insufficiently maintained	Signal components that are on the roadway or in signal rooms (wayside), such as relays, cables, or signal sources, are not maintained according to manufacturer or agency standards.	<p>a. Signal system fails to detect occupancy of track segment (false clear) as designed resulting in a train-to-train collision.</p> <hr/> <p>b. Signal system fails to properly route train through interlocking resulting in a train-to-train collision or derailment.</p> <hr/> <p>c. Signal system fails to control train movements as designed resulting in a train-to-train collision or derailment.</p>
2. Vehicle signal components insufficiently maintained	Signal components that are within a rail vehicle, such as receivers, relays, and cab signals, are not maintained according to manufacturer or agency standards.	<p>a. Signal system fails to control train movements as designed resulting in a train-to-train collision or derailment.</p>
3. Signal system design insufficiency	A signaling system is not designed to accommodate the current level of service or technology in use.	<p>a. Signal system fails to detect occupancy of track segment (false clear) as designed resulting in a train-to-train collision.</p> <hr/> <p>b. Signal system is designed to permit trains to move in violation of speed commands resulting in a train-to-train collision or derailment.</p> <hr/> <p>c. Signal system does not provide adequate vehicle spacing and stopping distances resulting in a collision.</p>

Hazard	Description	Potential Consequence
4. Signal system not present	A signal system is not present. Instead, the agency relies on line-of-sight and standard traffic signals to operate.	<p>d. Train operators or controllers fail to respond to signal system information resulting in a train-to-train collision or derailment.</p> <p>a. Train movement is not controlled by the RTA resulting in train-to-train collision or derailment.</p>

**Resources:**

**[APTA Rail Transit System Voluntary Standards](#)**

- [APTA RT-SC-S-009-03](#) **Audio Frequency Track Circuit Inspection and Maintenance** offers requirements necessary to assure the safety and reliability of audio frequency track circuit systems.
- [APTA RT-OP-SP-006-03](#) **Rail Transit Signals Operating Rules and Procedures** provides guidance for the development of rail transit system operating rules and procedures pertaining to signals. This document outlines the wide variety of signal systems and the requirements for rules pertaining to their operation.
- [APTA RT-SC-S-021-03](#) **Electric Train Stop Mechanism Inspection and Maintenance** provides guidance to ensure that electric train stop mechanisms are operating safely and as designed through periodic inspection and maintenance, thereby increasing reliability and reducing the risk of hazards and failures.
- [APTA RT-SC-S-028-03](#) **Vital Relay Testing** provides procedures for testing rail transit vital relays including guidance on testing frequency and tools required to test relays.
- [APTA RT-SC-S-035-03](#) **Vital Processor-Based System Inspection, Testing and Configuration Control** establishes requirements for the inspection, testing, and configuration control of vital processor-based interlocking and signal systems. This document only addresses vital processor system components.
- [APTA RT-SC-S-036-03](#) **Wayside Signal Inspection and Testing** provides procedures for inspecting and testing rail transit wayside signals and factors to establish testing frequencies.
- [APTA RT-SC-S-040-03](#) **Ac Track Circuit Inspection and Maintenance** provides procedures for inspecting and maintaining rail transit ac track circuits and factors to establish testing frequencies.

## Federal Transit Administration

- [FTA Safety Resources for Rail Transit Providers](#) provides a variety of resources to rail agencies including guidance and webinars on various Public Transportation Agency Safety Plan regulation topics such as developing Agency Safety Plans and understanding Safety Management Systems principles, including [SRM](#).

## Institute of Electrical and Electronics Engineers (IEEE)

- [IEEE 1474.1-2004 IEEE Standard for Communications-Based Train Control \(CBTC\) Performance and Functional Requirements](#) establishes a set of performance and functional requirements necessary for enhancing performance, availability, operations, and train protection using a CBTC system.
- [IEEE 1474.2-2003 IEEE Standard for User Interface Requirements in CBTC Systems](#) establishes consistent user interfaces that take advantage of the characteristics of CBTC systems to enhance service effectiveness of a rail transit system.
- [IEEE 1474.3-2008 IEEE Recommended Practice for Communications-Based Train Control System Design and Functional Allocations](#) establishes a preferred system design and functional allocation for enhanced safety performance.
- [IEEE 1474.4-2001 IEEE Recommended Practice for Functional Testing of a Communications-Based Train Control System](#) establishes a preferred approach for functional testing to enhance safety performance.
- [IEEE 1473-2010 IEEE Standard for Communications Aboard Passenger Trains](#) defines protocols to be used for intercar and intracar serial data communications between subsystems aboard passenger trains and minimum acceptable parameters for a network that can simultaneously handle monitoring and control traffic from multiple systems.

## Transit Advisory Committee for Safety (TRACS)

- [Characteristics of an Ideal State Safety Oversight Organization – TRACS Final Report 10-02](#) highlights the need for technical expertise within SSOAs regarding signal systems, including automated train control, automatic block systems, and cab signal systems.
- [Roadway Worker Protection – TRACS Final Report 18-02](#) references signal system safety as it relates to redundant protections for roadway workers. The report recommends that RTAs implement innovative safety technology for roadway worker protection that could include train control systems.
- [Trespass and Suicide Prevention – TRACS Final Report 18-03](#) states that positive train control could be integrated with trespassing detection systems to automatically slow or stop a train if a person is detected on the right-of-way.

## Federal Railroad Administration (FRA)

- [49 CFR part 236 – Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances](#) is the regulation governing signal systems and positive train control for agencies under FRA jurisdiction.

**Contact:** Please direct questions or comments regarding this Safety Advisory to Joseph DeLorenzo, Associate Administrator for Transit Safety and Oversight and Chief Safety Officer, FTA, 1200 New Jersey Avenue, SE, Washington, DC 20590, telephone (202) 366-1783, or [Joseph.DeLorenzo@dot.gov](mailto:Joseph.DeLorenzo@dot.gov).