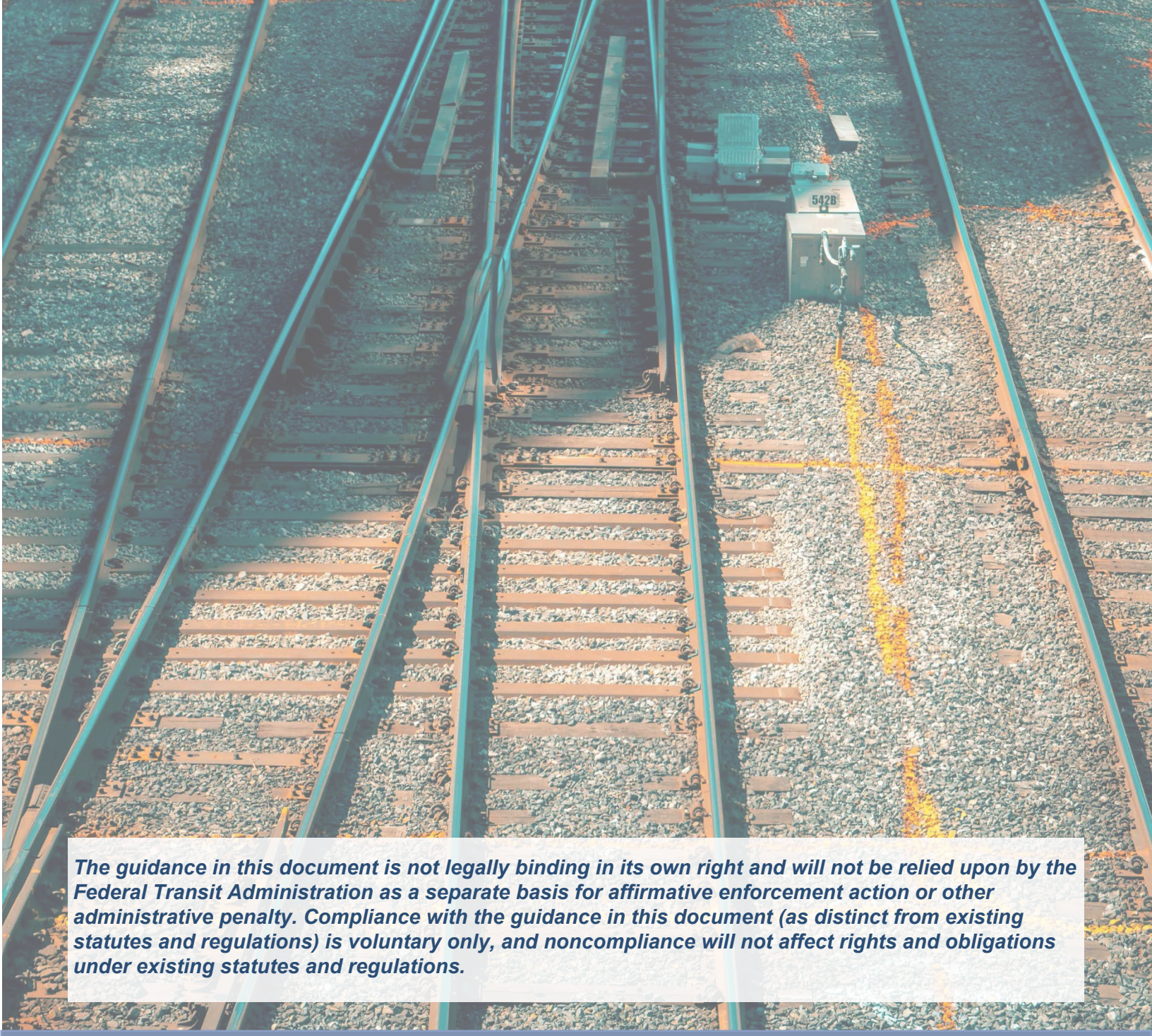

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# Sample Hazard Classification System

## Public Transportation Agency Safety Plan (PTASP) Implementation

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**Version 1**

U.S. Department of Transportation
Federal Transit Administration

# DOCUMENT OVERVIEW

The Public Transportation Agency Safety Plan (PTASP) regulation at 49 C.F.R. Part 673.25(b)(1) requires transit agencies to "establish methods or processes to identify hazards and the consequences of hazards" as part of their overall Safety Management System (SMS).

This document introduces a sample classification system for hazards in the transit environment. It suggests categories, groups them by type, and provides examples of specific transit safety hazards in each. The purpose of this document is not to prescribe a one-size-fits-all approach but rather to provide a model for transit agencies to consider in the initial stages of SMS development and implementation. It may also be useful for rail and bus transit agencies and State Safety Oversight Agencies (SSOAs) with more advanced SMS implementation or oversight processes to promote common understanding. This document does not address security threats or vulnerabilities.

# TABLE OF CONTENTS

# CHAPTER 1
# WHAT ARE HAZARDS AND CONSEQUENCES?

## SECTION 1.1

### What is a Hazard?

**A hazard is a condition with the potential to cause harm.**

The Federal Transit Administration (FTA) defines a hazard in 49 C.F.R. Part 673.5 as "any real or potential condition that can cause injury, illness, or death; damage to or loss of the facilities, equipment, rolling stock, or infrastructure of a public transportation system; or damage to the environment." There are many sources within a transit agency to support hazard identification, including the very important reporting of safety concerns by employees. A hazard holds potential that, when triggered, results in a consequence(s) that may cause harm or damage. The severity of the potential consequence(s) may range from negligible to catastrophic, depending on the nature of the hazard and the particular operational conditions.

## SECTION 1.2

### What is a Consequence

**A hazard can have many potential consequences.**

If a hazard lets us know "what's wrong," then a consequence tells us "what could happen." A consequence may result when the hazard's potential is triggered or acted upon. Within the Safety Risk Management process, transit agencies analyze an identified hazard to understand its potential consequences. The agency assesses how often a potential consequence could occur (likelihood) and its harm or damage (severity). This assessment results in an understanding of the safety risk associated with the hazard and helps management decide if action is needed to address the safety risk.

## SECTION 1.3

### Why Distinguish Hazards from Consequences?

When you are first alerted to a safety concern, it is important to correctly identify what exactly is contributing to the unsafe condition, i.e., the hazard. If we mistake a consequence for the hazard, we might not fully understand the actual safety concern and its true potential (safety risk) and the condition could worsen. In addition, if we mistake a consequence for the hazard, we also might allocate resources to address only the single consequence and miss other consequences that could cause equal or greater harm. When we consider safety risk, we want to allocate resources to address what *could* happen. Events have *already* happened. Safety Risk Management focuses on the future. To effectively mitigate the safety risk associated with a hazard, transit agencies will need to reduce the likelihood or severity of the potential consequences associated with the hazard.

## SECTION 1.4

## Why are Hazards Real or Potential?

FTA clarifies in its definition that hazards can be **real or potential conditions**:

| | |
|---|---|
| **Real Condition Hazards** | Involve conditions that occur in transit operations that must be managed to ensure safety. Examples include a sharp curve that requires the vehicle to slow down or worn brakes that do not perform as designed. |
| **Potential Condition Hazards** | Involve conditions that do not yet exist but that may exist in the future and result in harm, and, therefore, must be considered during planning, engineering, design, and construction. For example, a city is planning a new traffic pattern design that may introduce new left turns for buses at major intersections. The new left turns could potentially result in increased collisions at these inter-sections. |

Considering both real and potential conditions enables you to identify, assess, and mitigate the potential consequences of hazards throughout all life cycle phases. This includes from initial planning through engineering and construction, through operations and maintenance, to the disposal of retired components and elements.

## SECTION 1.5

## How can Hazards be Organized for Analysis?

Whether working on a new transit project or an existing operational system, you can organize identified hazards in a classification system to support your agency's data management and hazard prioritization activities. Hazard information can come from many sources including agency information gathering and analysis, active reporting from employees and the public, continuous monitoring of the information systems and data used in operations and maintenance, and routine observations of transit service.

You can also identify hazards through the use of tools, such as hazard lists, brainstorming sessions, guidance from FTA and SSOAs, and lessons learned from peers and industry associations.

There is no right or wrong approach to categorizing hazards. FTA recommends, however, that transit agencies consider the following classification matrix when establishing a classification system.

SECTION 1.6

## What does FTA's Sample Classification Matrix Look Like?

Some transportation modes, such as aviation, have established standard, industry-wide taxonomies (i.e., classification systems) to facilitate the storage, analysis, and retrieval of information regarding hazards. There is no industry-wide hazard taxonomy for public transportation. However, the following discussion provides classification guidance for transit industry stakeholders to develop hazard type categories and subcategories relevant and suitable to their specific context. Please see the table below.

| Hazard Type Category | Hazard Type / Subcategory |
|---|---|
| ***Organizational*** | Resourcing |
| | Procedural |
| | Training |
| | Supervisory |
| ***Technical*** | Operational |
| | Maintenance |
| | Design |
| | Equipment |
| ***Environmental*** | Weather |
| | Natural |

### Chapters 2-4: Discussion of Hazard Types

| | |
|---|---|
| **Chapter 2** | **Organizational Hazards** |
| **Chapter 3** | **Technical Hazards** |
| **Chapter 4** | **Environmental Hazards** |

## Sample Discussion using this classification system

A transit agency does not regularly monitor its operations (category: organizational hazard; subcategory: supervisory hazard). As a result, the agency has not noticed potential incidents at bus stops located on the near side of certain intersections in the agency's network (category: technical hazard; subcategory: operational hazard). Also, as bus operators approach these intersections, the placement of the rearview mirror forces operators to lean forward to achieve a complete view perspective of the intersection (category: technical hazard; subcategory: design hazard). Some operators are unable to lean far enough forward to have an unobstructed view.

Also, at this agency, the brakes of buses frequently collect moisture due to the particular brake design, reducing brake effectiveness (category: technical hazard; subcategory: maintenance hazard). This situation is aggravated when it rains (category: environmental hazard; subcategory: weather hazard) and by the slope prevailing in most streets due to the geography of the city (category: environmental hazard; subcategory: natural hazard).

Examples are provided for illustration only. Each agency will identify hazards relevant to their transit system.

## Are People Hazards?

FTA defines hazard as "any real or potential condition that can cause… [harm and damage]." A person is not a hazard because people are not conditions. People commit operational errors and may be engaged in activities with potential consequences. But people should not be assessed as you would assess a hazard. The operational conditions that led to the error should be assessed. Review the first classification system example in the "Sample Discussion" above. What happens if the agency in the example focused on people as hazards? It may have concluded that the potential consequence (striking a pedestrian in a crosswalk) was based solely on bus operators not leaning far enough forward for an unobstructed view of the intersection. The agency would have missed the underlying conditions that led to the error.

In classifying hazards, agencies should look beyond employees to the conditions within their operational context in order to identify the hazard. By identifying and addressing real or potential conditions, agencies can improve the context where service delivery operations take place, since even the best thought-out and well-planned systems cannot account in advance for all the conditions that could affect human behavior.

# CHAPTER 2
# ORGANIZATIONAL HAZARDS

## SECTION 2.1

## What are Organizational Hazards?

Organizational hazards are shortcomings in the organizational processes of transit agencies, such as planning, financing, budgeting, communication, supervision, training, and so forth. The shortcomings in these processes may impact the safety performance of a transit agency.

Organizational hazards do not usually generate direct consequences, rather they influence the conditions under which transit services are delivered. There usually is some intermediate operational condition(s) – that must be identified – in between the organizational hazard and the potential consequence. For example, deficiencies in maintenance training for mechanics (organizational hazard) lead to the dispatch of buses with ineffective brakes (technical hazard, the intermediate condition). This intermediate condition is what may lead to the potential consequences, for example, damage to vehicles from a collision between a bus and a car.

Unlike technical and environmental hazards, which are normally resolved at the supervisor level, organizational hazards require executive management resources and authorities to resolve them. In the example above, addressing deficiencies in maintenance training for mechanics falls under the executive management level, and, once it is fixed, resolving the condition of ineffective brakes falls under the supervisory level.

**EXAMPLE**

In response to a budget crisis, a transit agency reduces resources for training programs. Due to this reduction, training for bus operators on specific changes to operational conditions becomes outdated (organizational hazard). The city has introduced changes to bicycle and pedestrian crossing treatments (changed operational condition – technical hazard). Bus operators' procedures are not amended to reflect the change. The change in crossing treatment may lead to consequences, for example, collision between buses and bicycles or buses with pedestrians, that may result in damage and injuries. In this example, without breaking down the organizational hazard (outdated training) to understand its influence on operating conditions (change in crossing treatment), the potential consequences are hard to define and not obvious to mitigate. Differently put, the link between outdated training and collisions is neither obvious nor intuitive.

**Subcategories of Organizational Hazards include Resourcing Hazards, Procedural Hazards, Training Hazards, and Supervisory Hazards.**

## SECTION 2.2

## Examples of Resource Hazards

- Inability of the agency to staff and resource departments
- Lack of transition planning to manage turnover in key management and skilled labor positions
- Lack of qualified personnel in key operational positions
- Inadequate parts and materials available to maintain equipment
- Lack of qualified engineers to support maintenance functions

## SECTION 2.3

## Examples of Procedural Hazards

- Lack of procedures and manuals for conducting maintenance activities
- Incorrect, incomplete, or outdated procedures or manuals for conducting operations and maintenance activities
- Confusing or overly complicated procedures and manuals
- Overly cumbersome process for updating manuals and procedures
- Lack of or ineffective procedures to address fatigue in employee work scheduling
- Lack of or ineffective procedures to ensure employee fitness for duty and medical qualification
- Lack of or ineffective policies and procedures for managing substance abuse, over the counter medications, and prescription medications
- Lack of or ineffective procedures for reporting hazards and safety concerns

## SECTION 2.4

## Examples of Training Hazards

- Lack of or incomplete training on current procedures and requirements
- Outdated training that no longer reflects current operating practices
- Inconsistent, incorrect, or ineffective training
- Unavailable training on a new technology or system implemented by the transit agency
- Lack of internal and external communication to support training delivery, including language barriers
- Lack of skill or qualification in training delivery

SECTION 2.5

## Examples of Supervisory Hazards

- Lack of employee performance monitoring
- Inaccurate or confusing work instructions or verbal directions
- Lack of or poor management and labor relations
- Lack of employee compliance with operating and maintenance rules
- Lack of or ineffective audit and work observation procedures

# CHAPTER 3
# TECHNICAL HAZARDS

## SECTION 3.1

## What are Technical Hazards?

Technical hazards refer to the condition of equipment, facilities, and infrastructure needed to deliver transit service. As discussed in FTA's Transit Asset Management program, the condition of a public transportation system's capital assets—most notably, its equipment, rolling stock, infrastructure, and facilities—is critical to the system's safety and performance. If transit assets are not in a state of good repair, the consequences may include decreased system reliability, higher maintenance costs, and lower system performance. Each outcome could present a safety concern that must be managed by the transit system.

Technical hazards may also result from changes in the configuration of facilities or systems that have occurred over time, as well as changes in the operational environment.

**EXAMPLE 1**

A small bus agency in the Midwest is forced to change brake pads when its supplier goes out of business. The new brake pads do not have a chemical coating to provide protection from de-icing salts on roads. As a result, brake pads are deteriorating at a faster rate, leading to a loss of braking performance and an increase in reported safety events related to braking. The new brake pads' lack of chemical coating is a technical hazard that needs to be identified and addressed by the bus system.

**EXAMPLE 2**

Rail fasteners used with concrete ties help hold track in place (called track gauge restraint). Over time, rail fasteners become worn and corroded and pop out or fall away from the rail. Missing or broken fasteners reduce the track's gauge strength, leading, potentially, to wide gauge conditions that can derail a train or work vehicle. Missing or broken fasteners are a technical hazard that can be addressed through inspection and maintenance programs. Similarly, in the rail transit environment, over time, drains in the tunnels used by subway systems can fill with mud, rocks, and track material, limiting the effectiveness of the drainage system. Clogs lead to more water in the tunnel and greater corrosion of track and electrical components. Blocked drains are a technical hazard for these rail transit systems.

Technical hazards may also "creep" undetected into transit operations unless the transit agency has a formal procedure for hazard identification. For example, in 2014, FTA issued Safety Advisory 14-2 directing SSOAs and rail transit agencies (RTAs) to review the configuration of the systems,

technology, and procedures designed to guarantee safe stopping for a train in emergency braking at a terminal station. Over time, as RTAs increased approach speeds for stations, FTA found that the original configurations were no longer effective to stop trains from colliding with bumping posts and end walls. Therefore, FTA required SSOAs and RTAs to confirm that designated safe braking distances address the actual operating conditions in terminal stations. These conditions include authorized train speeds, train length and length of platform, the position of signals and trip stops, and the bumping post installation.

The subcategories of technical hazard types, like the subcategories of organizational hazards, can help classify hazards for analysis.

### Subcategories of Technical Hazards include Operational Hazards, Maintenance Hazards, Design Hazards, and Equipment Hazards

SECTION 3.2

## Examples of Operational Hazards

**Includes conditions that may impact the safety of transit operations.**

- Bicycle lane in front of, or adjacent to, a bus, trolley, or streetcar stop
- Entrance to an alley, private road, or driveway mid-block, on a curve or hill, or in another difficult-to-see location
- Construction work zones and detours
- Obstructions on the road or rail transit right-of-way, including tires, debris, and tree limbs
- Other drivers following a bus too closely or speeding
- Pedestrian crossings
- Industrial intersections
- Rail grade crossings
- Bicyclist turning beside or behind a bus or railcar
- Pedestrian access to bus lane
- Sun glare
- Tight clearances and narrow lanes
- Bus stops on hills and curves
- Vegetation blocking signs and limiting visibility at stops
- Multi-tasking limiting the effectiveness of rail controllers or bus dispatchers

## SECTION 3.3

## Examples of Maintenance Hazards

**Includes conditions involving the safety performance of equipment, vehicles, and infrastructure.**

- Wear and defects in electrical system components on buses
- Wear and defects in exhaust gas recirculation systems on buses
- Uneven wear on bus brake rotors
- Railcar wheel profile out of tolerance
- Worn rail transit system switch points
- Compromised structural integrity of elevated structure
- Cracked concrete crossties
- Worn signage in stations and subway tunnels
- Worn electrical connections and water intrusion compromising operation of railcar's passenger doors
- Aging, mud-encased power cables conducting electrical current and arcing at joints, on insulators, or at third rail mounting hardware
- Worn electrical systems on trains shorting out and stalling trains in tunnels and on elevated structures

## SECTION 3.4

## Examples of Design Hazards

- Difficulty of accessing maintenance panels in rail and bus vehicles
- Inability to use rear view and side mirrors on a bus without the operator adjusting their body and head position
- Difficulty of using and interpreting information on a visual display board for train operation, including location of ventilation fans and emergency trip stops
- Selection of tile materials that crack and come loose, creating tripping obstacles for passengers
- Constant alarms issued by automated logic of the track circuit system, without ranking or priority
- High level of skill required to berth a train at platform
- Displays in operations control center not easy to understand due to placement

SECTION 3.5

## Examples of Equipment Hazards

- Tools not properly calibrated
- Flashlight batteries do not hold their charge
- Inoperable communications equipment
- Worn and dirty personal protective equipment is no longer reflective
- Degraded condition of flashers and lanterns used to set up a worker protection zone
- Emergency repair kits not maintained

# CHAPTER 4
# ENVIRONMENTAL HAZARDS

## SECTION 4.1

### What are Environmental Hazards?

The natural environment causes conditions that result in environmental hazards, such as snow, ice, rain, and wind. All public transportation systems, regardless of mode, experience environmental hazards.

**EXAMPLE 1**

A transit agency may implement speed restrictions on a bus route that frequently experiences heavy fog or a transit system may institute special radio call-in procedures to monitor locations prone to flash flooding during rain storms. Because transit agencies manage environmental hazards as part of their daily operations, they may inadvertently neglect to account for them properly or may underestimate their damaging potential.

While transit agencies cannot control environmental hazards, they can adapt to them or mitigate their effects.

The subcategories of environmental hazard types, like the subcategories of organizational and technical hazards, can help classify hazards for analysis.

### Subcategories of Technical Hazards include Weather Hazards and Natural Hazards

## SECTION 4.2

### Examples of Weather Hazards

- Rain, fog, and thunderstorms
- Flooding
- Freezing rain, snow, and icing conditions

## SECTION 4.3

### Examples of Natural Hazards

- Wildlife (deer on roadway)
- Adverse terrain (hills, curves, bridges)
- Large bodies of water