TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

AGENCY SAFETY PLAN (ASP)

PORTLAND, OREGON

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Record of Revisions

Publish date	Version number	Page(s) affected/Persons	Description of revision	Approved by
8/31/20	001	Agency	SSE Agency Safety Plan submittal for review and approval by TriMet's accountable executive and leadership	
			Review and submission to the TriMet board of directors	
			Agency Safety Plan submittal to ODOT for review and approval	
			Receipt of Agency Safety Plan approval from ODOT	
			Approved ASP submission by TriMet to FTA	

Acronyms

ASP	**Agency Safety Plan, (aka Public Transit Agency Safety Plan "PTASP")**
ACID	**Accident Incident Database**
ALARP	**As Low As Reasonably Practicable**
BDS	**Bus Dispatch System**
CBD	**Central Business District**
CFR	**Code of Federal Regulations**
CAP	**Corrective Actions Plan**
CIP	**Capital Improvements Program or Plan**
EIC	**Employee In Charge**
EIS	**Environmental Impact Statement (See 'FEIS' and 'DEIS')**
FRA	**Federal Railroad Administration**
FTA	**Federal Transit Administration**
KPI	**Key Performance Indicators**
LRT	**Light Rail Transit**
LRV	**Light Rail Vehicle**
MAX	**Metropolitan Area Express**
MOW	**Maintenance of Way**
MPO	**Metropolitan Planning Organization**
NRV	**Non-Revenue Vehicle**
NTD	**National Transit Database**
NTSB	**National Transportation Safety Board**
OAR	**Oregon Administrative Rules**
OCC	**Operations Control Center**
ODOT	**Oregon Department of Transportation**
PHA	**Preliminary Hazard Analysis**
ROW	**Right of Way**
RSA	**Request for Safety Assessment**
RWP	**Roadway Worker Protection**
SA	**Safety Assurance**
SMS	**Safety Management System**
SP	**Safety Promotion**
SRM	**Safety Risk Management**
SSE	**TriMet Safety, Security, and Environmental Division**
SSOA	**State Safety Oversight Agency**
SSPP	**System Safety Program Plan**
TAM	**Transit Asset Management**
TCRC	**Transit Change Review Committee**

TriMet **Tri-County Metropolitan Transportation District of Oregon**

Definitions

Acceptable Risk	The tolerable level of risk to people and property.
Accident	An event that involves any of the following: A loss of life; a report of a serious injury to a person; a collision of public transportation vehicles; a runaway train; an evacuation for life safety reasons; or any derailment of a rail transit vehicle, at any location, at any time, whatever the cause.
Accountable Executive	A single, identifiable person who has ultimate responsibility for carrying out the Public Transportation Agency Safety Plan of a public transportation agency; responsibility for carrying out the agency's Transit Asset Management Plan; and control or direction over the human and capital resources needed to develop and maintain both the agency's Public Transportation Agency Safety Plan, in accordance with 49 U.S.C. 5329(d), and the agency's Transit Asset Management Plan in accordance with 49 U.S.C. 5326.
Administrator	The Federal Transit Administrator or the Administrator's designee.
As Low As Reasonably Practicable	Acceptable risk based on risk reduction mitigation.
Corrective Action Plan	Means a plan developed by an RTA that describes the actions the RTA will take to minimize, control, correct, or eliminate risks and hazards, and the schedule and responsibility for implementing those actions.
Chief Safety Officer	An adequately trained individual who has responsibility for safety and reports directly to a transit agency's chief executive officer, general manager, president, or equivalent officer.
Close Call (Near Miss)	An unplanned event that did not result in injury, illness, or damage - but had the potential to do so.
Equivalent Authority	An entity that carries out duties similar to that of a Board of Directors, for a recipient or sub recipient of FTA funds under 49 U.S.C. Chapter 53, including sufficient authority to review and approve a recipient or sub recipient's Agency Safety Plan.
Event	Any Accident, Incident or Occurrence.

Hazard	Any real or potential condition that can cause injury, illness, or death; damage to or loss of facilities, equipment, rolling stock, or other infrastructure of a public transportation system; or, damage to the environment.
Hazard Analysis	The formal activities to analyze potential consequences of hazards during operations related to provision of service.
Hazard Identification	The formal activities to identify potential hazards during operations related to provision of service.
Incident	An event that involves any of the following: A personal injury that is not a serious injury; one or more injuries requiring medical transport; or damage to facilities, equipment, rolling stock, or infrastructure that disrupts the operations of a transit agency. An event where no injury or damage occurs but injury or damage could have occurred – i.e. near miss or narrow escape.
Investigation	The process of determining the causal and contributing factors of an accident, incident, or hazard, for the purpose of preventing recurrence and mitigating risk.
Map-21	MAP-21 grants FTA the authority to establish and enforce a new comprehensive framework to oversee the safety of public transportation throughout the United States as it pertains to heavy rail, light rail, buses, ferries, and streetcars. The law requires, among other things, that FTA update the State Safety Oversight (SSO) program to ensure that rail transit systems are meeting basic, common-sense safety requirements.
National Public Transportation Safety Plan	The plan to improve the safety of all public transportation systems that receive Federal financial assistance under 49 U.S.C. Chapter 53.
Occurrence	An Event without any personal injury in which any damage to facilities, equipment, rolling stock, or infrastructure does not disrupt the operations of a transit agency.
Operator	A provider of public transportation as defined under 49 U.S.C. 5302(14).
Performance Measures	An expression based on a quantifiable indicator of performance or condition that is used to establish targets and to assess progress toward meeting the established targets.
Performance Target	A quantifiable level of performance or condition, expressed as a value for the measure, to be achieved within a period required by the Federal Transit Administration (FTA).

Public Transportation Agency Safety Plan	The comprehensive agency safety plan for a transit agency that is required by 49 U.S.C. 5329 and 49 CFR Part 673.
Rail fixed guideway public transportation system	Any fixed guideway system that uses rail, is operated for public transportation, is within the jurisdiction of a State, and is not subject to the jurisdiction of the Federal Railroad Administration, or any such system in engineering or construction. Rail fixed guideway public transportation systems include but are not limited to rapid rail, heavy rail, light rail, monorail, trolley, inclined plane, funicular, and automated guideway.
Rail Transit Agency	Any entity that provides services on a rail fixed guideway public transportation system.
Risk	The composite of predicted severity and likelihood of the potential effect of a hazard.
Risk Mitigation	A method or methods to eliminate or reduce the effects of hazards.
Risk Probability	The likelihood that a consequence might occur, taking as reference the worst foreseeable–but credible–condition.
Security	Freedom from intentional harm.
Severity	The anticipated effects of a consequence, should it materialize, taking as reference the worst foreseeable–but credible–condition.
Safety	Freedom from unintentional harm.
Safety Assurance	A processes within a transit agency's Safety Management System that functions to ensure the implementation and effectiveness of safety risk mitigation, and to ensure that the transit agency meets or exceeds its safety objectives through the collection, analysis, and assessment of information.
Safety Management Policy	A transit agency's documented commitment to safety, which defines the transit agency's safety objectives and the accountabilities and responsibilities of its employees with regard to safety.
Safety Management System (SMS)	The formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of a transit agency's safety risk mitigation. SMS includes systematic procedures, practices, and policies for managing risks and hazards.
Safety Management System Executive	The Chief Safety Officer or an equivalent.
Safety Performance Target	A Performance Target related to safety management activities.

Safety Promotion	A combination of training and communication of safety information to support SMS as applied to the transit agency's public transportation system.
Safety Risk	The assessed probability and severity of the potential consequence(s) of a hazard, using as reference the worst foreseeable, but credible, outcome.
Safety Risk Assessment	The formal activity whereby a transit agency determines Safety Risk Management priorities by establishing the significance or value of its safety risks
Safety Risk Management	A process within a transit agency's Public Transportation Agency Safety Plan for identifying hazards and analyzing, assessing, and mitigating safety risk.
Safety, Security and Environmental Services	The TriMet division responsible for the ASP development and SMS implementation oversight.
Serious Injury	Any injury which: 1) Requires hospitalization for more than 48 hours, commencing within 7 days from the date of the injury was received; 2) Results in a fracture of any bone (except simple fractures of fingers, toes, or nose); 3) Causes severe hemorrhages, nerve, muscle, or tendon damage; 4) Involves any internal organ; or 5) Involves second- or third-degree burns, or any burns affecting more than 5 percent of the body surface.
State Safety Oversight Agency	An agency established by a State that meets the requirements and performs the functions specified by 49 U.S.C. 5329(e) and the regulations set forth in 49 CFR Part 674. For Oregon, the SSOA is the Oregon Department of Transportation, ODOT.
Transit Agency	An operator of a public transportation system.
Transit Asset Management Plan	The strategic and systematic practice of procuring, operating, inspecting, maintaining, rehabilitating, and replacing transit capital assets to manage their performance, risks, and costs over their life cycles, for the purpose of providing safe, cost-effective, and reliable public transportation, as required by 49 U.S.C. 5326 and 49 CFR Part 625.
Tolerable	A condition when benefits justify risk acceptance.

Foreword

The Tri-County Metropolitan Transportation District of Oregon (referred to herein as "TriMet") operations are dependent upon the proficiency and well-being of its employees and maximizing its capital resources. To ensure preservation and safety of these resources, TriMet is adopting a comprehensive Safety Management System (SMS), with system safety at its foundation, and the model for safety management and continuous safety performance improvement.

To help a safe industry stay safe and become even safer, FTA has adopted the Safety Management Systems (SMS) as the new safety regulatory framework. With a focus on organization-wide safety policy, proactive hazard management, strong safety communication between front line employees and management, targeted safety training, and clear accountabilities and responsibilities for critical safety activities, SMS provides an enhanced structure for addressing expectations specified by Congress in the Moving Ahead for Progress in the 21st Century Act (MAP-21). On July 6, 2012, President Obama signed MAP-21, reauthorizing surface transportation programs through fiscal year 2014. Each reauthorization amends the Federal Transit Laws codified in 49 USC Chapter 53. MAP-21 took effect on October 1, 2012.

SMS also provides dedicated tools and approaches to help FTA implement outstanding recommendations from the National Transportation Safety Board (NTSB) regarding needed improvements in safety and oversight programs in both rail and bus modes. FTA has integrated various levels of SMS elements into the Interim Provisions to help a safe industry become even safer.

TriMet's Agency Safety Plan (ASP) serves as an over-arching framework guiding TriMet's agency-wide coordinated effort of all divisions to apply operating, technical, and risk management techniques and principles to conserve life and property; prevent and reduce mishaps and associated consequences to maintain a healthful work environment. FTA's SMS framework presents the SMS in four main components as shown below.

Figure 1: FTA SMS Framework

The ASP replaces the System Safety Program Plan (SSPP), which previously guided TriMet's safety efforts. Specifically, the ASP:

- states TriMet's commitment and philosophy to actively sustain safe transit operations;
- manages safety activities intended to minimize risk and loss of TriMet resources, and maximize safety;
- integrates the safety function throughout the TriMet organizational structure, from the COO, to managerial staff, to front-line employees;
- defines organizational safety responsibilities and accountabilities;
- provides for the documentation and verification of safety activities;
- Evaluates those activities for continuous improvement opportunities and aligns with the four components of SMS – Safety Management Policy, Safety Risk Management, Safety Assurance and Safety Promotion.

The ASP applies to TriMet's bus, light rail, and para-transit operations; the supporting divisions; and activities that involve the operation, and maintenance of the transit system. TriMet is subject to FTA's State Safety Oversight (SSO) Program, as stated in 49 CFR Part 674. TriMet has developed this ASP in compliance with 49 CFR Part 673 and the Oregon Department of Transportation (ODOT) SSO Agency's Program Standard. TriMet's ASP replaces its previously established System Safety Program Plan (SSPP) and requires annual review and revision (as necessary) and subsequent approval by TriMet's Board of Directors. Each of TriMet's divisions and department management teams are charged with the responsibility of implementing and assuring the success of the ASP.

TriMet's commuter rail system is covered under a separate system safety program plan (SSP). The commuter rail SSP conforms to the requirements of the Federal Railroad Administration's (FRA) rule, 49 CFR Part 270 – System Safety Program.

Due to the confidential nature of TriMet security measures, TriMet's System Security Plan (SSP) is maintained separately from the ASP. Emergency Response requirements outlined in 49 CFR Part 673.11 (a)(6) for emergency management programs, document control and coordinated schedule, exercises and drills and EOP annexes are covered in two documents: the Emergency Operations Plan and the Continuity of Operations plan. The Emergency Operations Plan (EOP) and the Continuity of Operations Plan (COOP) are attachments to the ASP and found in Annex B.

Introduction

The purpose of the Agency Safety Plan (ASP) is to establish a formal process that TriMet departments must use to identify hazards associated with TriMet's system; eliminate, minimize or control hazards; and to prevent injuries, accidents and other losses. This ASP demonstrates TriMet's commitment to Safety Management Systems (SMS) as described in Federal Transit Administration's 49 CFR, Part 673 and follows the Oregon DOT State Safety Oversight (SSOA) Program Standard and the four components of SMS: Safety Management Policy, Safety Risk Management, Safety Assurance, and Safety Promotion.

TriMet Mission and Vision

TriMet's mission statement, vision and values are:

Vision	TriMet will be the leader in delivering safe, convenient, sustainable and integrated mobility options necessary for our region to be recognized as one of the world's most livable places.
Mission	Connect people with valued mobility options that are safe, convenient, reliable, accessible and welcoming for all.
Values	Safety · Inclusivity · Equity · Community · Teamwork

System Description

TriMet provides bus, light rail and commuter rail service in the Portland, Oregon, region. TriMet's extensive Light Rail, commuter rail, bus routes and paratransit service move more than 315,000 passengers per day.

TriMet provides safe, reliable and efficient bus transit and paratransit service in the urbanized areas of Multnomah, Washington, and Clackamas counties, and light rail transit (LRT) service through the cities of Gresham, Portland, Beaverton, Milwaukie, and Hillsboro, Oregon. Service is also provided to the Portland International Airport.

TriMet's Westside express (WES) offers commuter rail service between Wilsonville and Beaverton, utilizing existing freight trackway. A chapter that presents a brief history of light rail system development, a summary of the modes of service, and an overview of TriMet facilities and vehicles is provided in the **Annex: TriMet System Description.**

Goals and Objectives of ASP

TriMet's safety goal is to design, construct, test, and operate a transportation system that attains an optimum level of safety through the effective management of safety risks. This goal is reflected throughout the planning, design, construction, operation, and maintenance phases. The ASP is foundational for achieving this goal within the TriMet's strategic goals and constraints and is accomplished, in part, through the application of a formal system of analytical techniques and methods for the identification, analysis, evaluation, and resolution of safety risks.

The primary objectives of the ASP are to implement strategies to achieve a level of safety performance that meets or exceeds the operating experience of similar bus and light rail transit systems in the United States. Methods and strategies are intended to:

- Reduce system injuries by fully analyzing employee and passenger injuries;
- Reduce employee injuries by ensuring employee compliance with OR-OSHA rules, local codes and federal, state, and local environmental regulations and TriMet requirements;
- Increase District safety by using industry standards to identify, assess, evaluate and mitigate hazards that may impact customer, employee and operational safety;
- Incorporate safety, fire protection, and emergency management measures into design criteria and specification development and in all transit system designs;
- Reduce future collisions by analyzing bus and light rail vehicle collisions, mishaps and other incidents and recommending operational and design improvements;
- Train TriMet personnel in safety related programs and ensure that safety certifications are up to date and maintained;
- Increase employee reporting of hazards and risks;
- Increase and strengthen community engagement in the safety of the transit system by involving and educating community organizations and schools in bus and light rail safety;
- Promote transit safety through campaigns and other activities;
- Improve planning and projections for fiscal support by tracing and analyzing historical data;
- Coordinate and communicate safety risks with jurisdictional partners and the Oregon Department of Transportation (ODOT) Rail and Public Transit Division.

ASP Development

Changes in the transit system operational configuration; management organization; the environment in which the transit system operates; safety policies, goals, or objectives; or regulatory requirements may require revision of the ASP and/or its implementation. The ASP is reviewed annually to ensure that it remains current and effective.

TriMet's SSE Division is authorized by the General Manager to develop, implement, and administer the ASP, through the Chief Operating Officer. The Executive Director of the SSE Division is responsible for the ASP review process and revisions if needed. Development and preparation of the ASP is in accordance with the documents listed below. Modification to these documents may result in updates to the ASP as necessary to maintain conformance.

- Federal Transit Administration (FTA) regulation: Rail Fixed Guideway Systems; State Safety Oversight, 49 CFR, Part 673;
- ODOT regulation - ODOT State Safety Oversight Program Standards Oregon Administrative Rules (OAR) 741-060-0010 through 0110.

FRA regulations as they pertain to the limited connection and eight rail-grade crossing along the Portland-Milwaukie segment of the Light Rail Transit System (LRT) (see System Description) 49 CFR Part:

- 214 - Roadway Worker Safety Program
- 217 - Operational Testing Program

- 219 - Control of Drug and Alcohol Use
- 220 - Radio Communications
- 222 - Quiet Zones
- 225 - Accident/Incident Reporting and Internal Control Plan
- 228 - Hours of Service – (Controllers and Signal Maintainers only)
- 233 - Signal Systems Reporting (applicable only to the OPRR crossing)
- 234 - Systems for Telephonic Notification of Unsafe Conditions at Grade Crossings
- 236 - Railroad Signals Maintenance Standards (applicable only to the OPRR crossing)
- 243 – Training, Qualification and Oversight for Safety-Related Railroad Employees

ASP Reviews and Updates

The following departments and personnel are responsible for initiating, developing, approving, and issuing changes to the ASP:

- General Manager
- Chief Operating Officer (Accountable executive)
- Executive Director of Safety and Environmental Services (Chief safety officer)
- Executive Director of Maintenance Operations
- Executive Director of Transportation Operations
- Executive Director of Human Resources and Labor Relations
- Executive Director of Engineering and Construction
- Senior Management
- Transit Change Review Committee
- Safety and Security Committee

After submission of an updated TriMet ASP, ODOT will acknowledge receipt within two days. If submission is favorable for review, ODOT will acknowledge acceptance within 45 days. An ODOT request or any number of other variables could warrant an assessment and update of the ASP more frequently than the annual minimum. New regulations, significant organizational structure changes, and/or internal or external audit review activities could prompt additional assessments. TriMet's SS & ES works closely with ODOT SSO for guidance and technical assistance during the ASP approval process. If the ASP submission is not sufficient for approval, ODOT notifies TriMet and requests additional documentation or clarification. Upon receipt of requested information, the process restarts. If the ASP fails to comply with the ODOT SSO Program Standard, TriMet is formally notified via letter.
If the Accountable Executive determines that the ASP is not current, the letter must detail TriMet's action plan to achieve compliance. Once the ASP is approved, TriMet is required to submit a formal letter of certification signed by TriMet's Accountable Executive to notify ODOT that the ASP is current and in compliance with ODOT SSO Program Standard.

ASP Review and Update Schedule

The ASP is reviewed during December of each year. The SS & ES Executive Director or designee, is responsible for the annual review, and advises the Transit Change Review Committee (TCRC) of ASP status. Significant changes to the ASP, other than organizational updates, personnel matters,

procurement, service plans and general asset/capital management and minor revisions, are submitted to TCRC for review. Updates and reviews will assure compliance with the current ODOT Program Standard. Any needed changes are incorporated into the document; approved by the Accountable Executive and District leadership; presented to the board for approval; then sent to ODOT for review and approval in February of each year. The focus of the review is to:

- Evaluate current safety programs and initiatives for appropriateness.
- Refine and improve program descriptions and activities.
- Identify new tasks and initiatives, which may be required.
- Define organizational responsibility for accomplishing safety–related tasks.
- Incorporate organizational, operational, or legislative changes.
- Assure continuous improvements are implemented.

Periodic reviews may be needed due to major system changes such as:

- Line Extensions
- New construction or modification of existing vehicles, facilities or system equipment
- Significant changes to operational practices
- Changes to Oversight regulations

On an annual basis, the Executive Director of SS &ES completes a comprehensive review of the ASP, addresses needed updates, and ensures that the ASP is compliant with 49 CFR Part 673 and the ODOT SSSO Program Standard. Upon final certification, the Vice President, CSO reviews the final ASP with the Accountable Executive ensuring that all signatures (including Board of Directors approval) are included on the approval page of the ASP.

TriMet must maintain documents that are included in whole, or by reference, that describe the programs, policies, and procedures that the agency uses to carry out its Agency Safety Plan. These documents must be maintained for three years and made available to any federal or state agency requesting it in accordance with Part 673.31.

ASP Distribution

Following the approval and execution of the ASP, the original copy is maintained in the office of the SS & ES. An electronic copy will be made available to all TriMet employees, and is available on the company TriNet website, under the safety area. This process will be initiated and supervised under the direction of the System Safety Manager. A hard copy of the current ASP will be provided to each executive at TriMet. Executives, managers and safety committee chairs are to use these copies to review the ASP with their staff. A summary of changes and updates is also provided with each revision update. Revisions and updates will be reviewed with members of the TCRC within the first meeting following the approval of the current ASP.

State Safety Oversight Authority

FTA regulates rail transit agencies (RTAs) by granting states authority to develop safety oversight programs, as defined by 49 CFR 674, and works cooperatively to ensure that light rail transit and streetcar operations comply with state and federal requirements.

The FTA functions as both an administrator of funds for capital projects and as a federal regulator as defined by 49 CFR 670 and 673. The FTA regularly audits the state safety oversight agency (SSOA) to determine its compliance with the general requirements. For Oregon, the SSO function resides in the Oregon Department of Transportation's (ODOT) SSO program is authorized under Oregon Revised Statute (ORS) 824.045 "Department establishment of system safety program for rail fixed guideway system".

SSO Program Standard Requirements

This section will be added once the program standard is completed.

FTA Requirements

Published in July 2018, 49 CFR, Part 673, establishes requirements for ASPs in order to carry out the explicit statutory mandates of the Moving Ahead for Progress in the 21st Century Act (Pub. L. 112-141; July 6, 2012) (MAP-21), which was reauthorized by the Fixing America's Surface Transportation Act (Pub. L. 114-94; December 4, 2015) (FAST Act), and codified as 49 U.S.C. 5329(d) to strengthen the safety of public transportation systems receiving Federal financial assistance under 49 U.S.C. Chapter 53. The rule requires Rail Fixed Guideway Public Transportation Systems to adopt SMS principles and methods; to develop, certify, implement, and update PTASPs; and to coordinate PTASP elements with other FTA programs and rules, as specified in 49 U.S.C. 5303, 5304, and 5329. 49 CFR Part 673 became effective on July 19, 2019, and TriMet is required to have its PTASP approved by ODOT's SSO Program by July 20, 2020 (In light of the extraordinary operational challenges presented by the COVID-19 public health emergency, FTA issued a Notice of Enforcement Discretion **effectively extending the PTASP compliance deadline from July 20, 2020 to December 31, 2020., FTA, 2020)**

SMS Component I – Safety Policy

The Safety Policy section shows TriMet's commitment to safety, which defines the safety objectives and the accountabilities and responsibilities of its employees concerning safety. TriMet has developed the following principles to serve as the primary roles to help do their part in the region by providing service and capital projects that:

- **Support our economy:** Getting employees to work and customers to businesses
- **Ease congestion:** Attracting many riders during peak periods and providing the kinds of service and capital projects that lead to development and lifestyles that rely less on peak-period driving
- **Provide mobility for those with few options:** Providing a critical service for seniors, people with disabilities, school kids, low-income households without cars and others who have few mobility options, getting them to work, school and other needs
- **Help shape the future of our region:** Delivering service and capital projects that help attract residents, businesses and development to centers, main streets and corridors that communities have identified as future growth areas

TriMet system has established a Safety Management Policy Statement for its system listed in the subsequent sections

1.1. Policy Statement

Safety is TriMet's highest core value and an essential business function. TriMet is committed to developing, implementing, maintaining, and continually improving processes and procedures designed to ensure the highest practicable level of safety performance. In support of this commitment, all transit service activities, from planning through operations, will receive a balanced allocation of organizational resources. TriMet's commitment is demonstrated by:

- Clearly defining responsibilities and accountabilities for the delivery of TriMet's safety management system performance through all levels of District staff;
- Integrating safety management into the primary responsibilities of all managers and employees;
- Valuing safety management as highly as other TriMet management systems;
- Supporting safety management with appropriate resources;
- Continue to build a culture of safety that fosters safe work practices and encourages employees to report actual or potential unsafe conditions;
- Implementing procedures for hazard identification, analyzing and evaluating the levels of risk associated with an identified hazard, and, mitigate those that exceed acceptable levels of risk;
- Complying with state and federal regulations, and TriMet safety requirements;
- Ensuring that all staff are provided with adequate and appropriate safety-related information and training;

- Establishing realistic safety performance goals and collecting appropriate and sufficient data by which to measure our progress and achievements;
- Continually improving our safety performance through management oversight that ensures appropriate and effective actions are taken;
- Ensuring externally supplied systems and services meet TriMet's safety performance standards;
- Improve system safety and security for all mobility options.

System Safety is a core value at TriMet, so we must include our safety values in everything we do. Amid all the details, we must continue to foster a culture of safety and strive to provide service where all of our riders and employees feel safe and secure.

Disciplinary action will not be taken against an employee who acts to prevent an injury or who reports an accident, incident, or hazard. All employees are required to abide by the standards and procedures set forth in the ASP.

Delegation of Authority and Accountability in SMS

The TriMet Board of Directors has delegated the authority and accountability for operations to the General Manager. The General Manager has designated the Accountable Executive of Safety to the Chief Operating Officer who is responsible for day-to-day safety of TriMet operations.

The General Manager has designated the Chief Safety Officer (CSO) as the SMS Manager and delegated the CSO authority for the day-to-day Agency oversight of safety for all operating systems. The CSO is a direct report to the COO and The CSO is responsible for the implementation and operation of the Agency's SMS.
The Executive Director of Safety and Security will maintain a dotted line direct to the General Manager.

This ASP will be approved for implementation under authority and accepted by the Chief Operating Officer and the TriMet Board of Directors.

1.2. Executive Signatures

Following general requirements and guidelines from 49 CFR 673, in compliance with the Fixing America's Surface Transportation (FAST) Act and to meet FTA and State Safety Oversight Requirements, TriMet has developed our Agency Safety Plan as our governing system safety plan.

As Executives, Directors, and Senior Leaders of the agency, we have reviewed and endorse our ASP. We also understand that we have the authority and responsibility for day-to-day implementation and operation of TriMet's Safety Management System (SMS).

Date of Approval: _____

Douglas Kelsey
General Manager

Roland Hoskins
Executive Director, Maintenance

Sam Desue, Jr
Chief Operating Officer (Accountable Executive)

Steven Witter
Executive Director, Engineering & Construction

(Vacant)
Executive Director, Transportation

Marla L. Blagg
Digitally signed by Marla L. Blagg
Date: 2020.10.08 08:49:28 -07'00'

Marla Blagg
Executive Director, Safety, Security – Chief Safety Officer

1.3. TriMet Performance Targets

TriMet's safety goal is to design, construct, test, and operate a transportation system that attains an optimum level of safety through the effective management of safety risks.

The ASP is foundational for achieving this goal within the TriMet's strategic goals and constraints and is accomplished, in part, through the application of a formal system of analytical techniques and methods for the identification, analysis, evaluation, and resolution of safety risks. This section describes the overall safety requirements and activities directed towards achieving the established TriMet safety goals and objectives. TriMet's annual safety performance targets are:

- Injuries per 1,000,000 boardings
  - Light Rail less than 1.9
  - Bus less than 1.9
- Fatalities per fiscal year
  - Light Rail 0.0
  - Bus 0.0
- Reportable Serious Injuries per 100,000 miles
  - Light Rail less than 2.0
  - Bus less than 0.5
- System Reliability - Mean distance between major mechanical failures
  - Light Rail greater than 10,000 miles
  - Bus greater than 15,000 miles
- Collision rate per 100,000 miles:
  - Light Rail less than 1.3
  - Bus less than 2.6
- Lost time employee injuries per 200,000 hours worked
  - less than 5.4
- OSHA recordable injuries in fiscal year
  - Less than 200 for all employees

TriMet will use existing and new systems to collect accurate and pertinent data to monitor and measure performance and report on status towards meeting targets. Performance targets will be made available and coordinated to State Safety Oversight and Metropolitan Planning Organizations as directed.

1.4. Organizational Structure

1.4.1. Organizational Charts

Each level of the District's organization is assigned responsibility for ensuring TriMet operations provide for the safety of customers, the public and District personnel, in accordance with the ASP. The following organizational charts depict the District's structure.

- Figure 1.1 TriMet Organizational Chart
- Figure 1.2 Safety, Security and Environmental Services Division
- Figure 1.3 Safety and Environmental Department

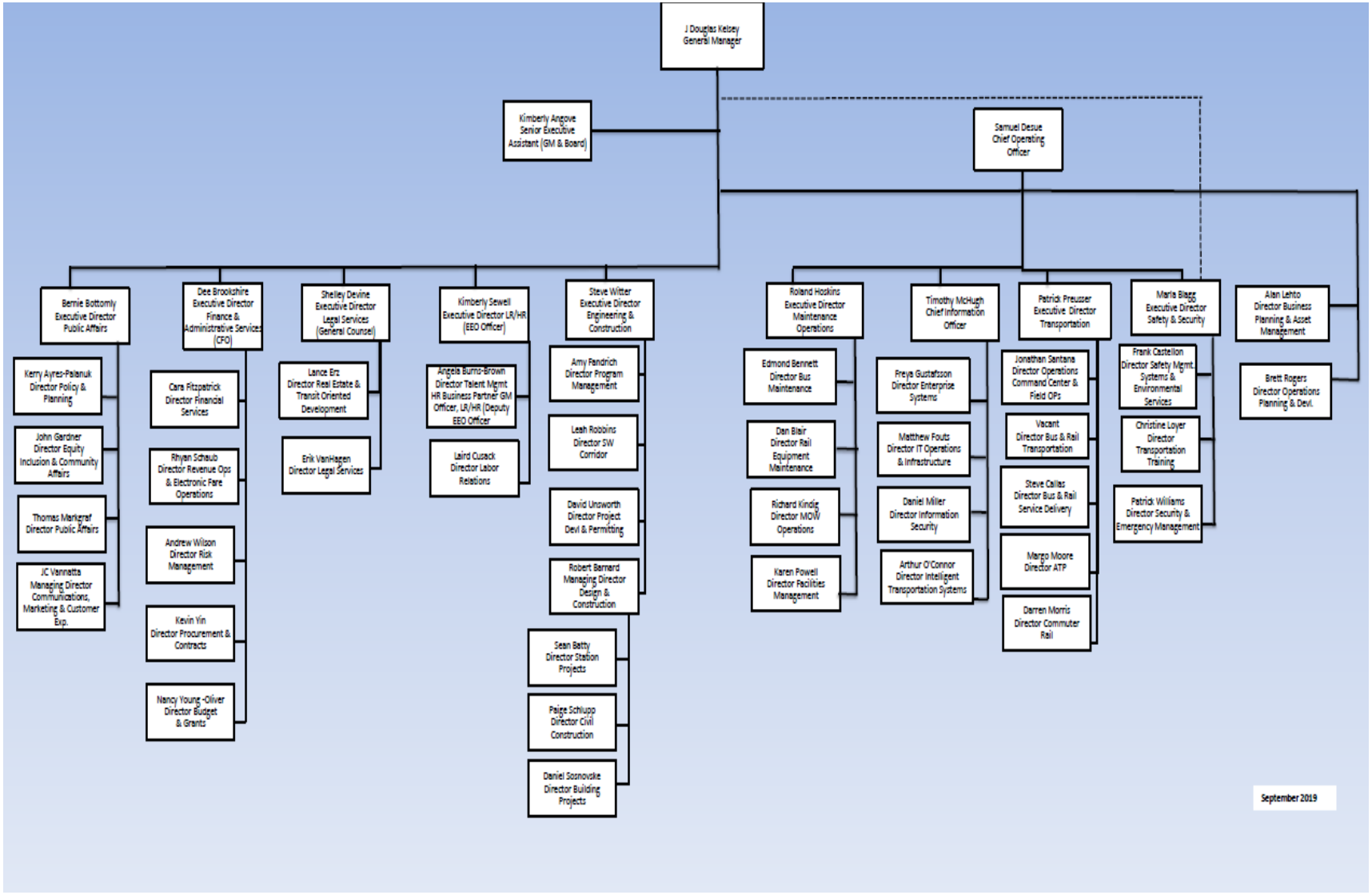


Figure 2: TriMet Organizational Chart

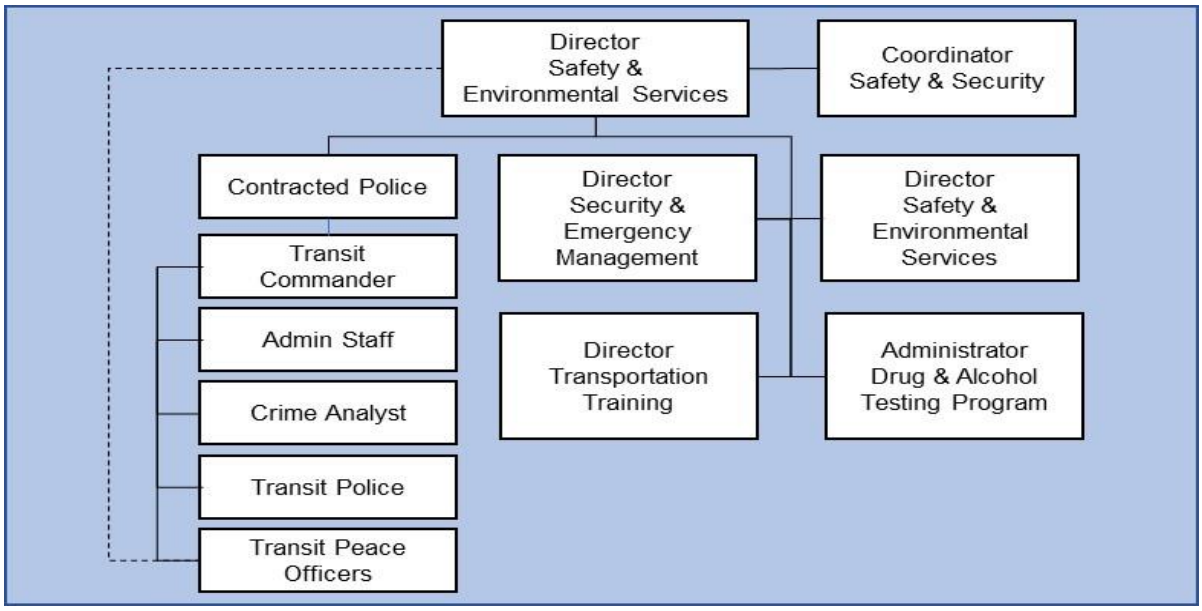


Figure 4: TriMet Safety and Environmental Services Department

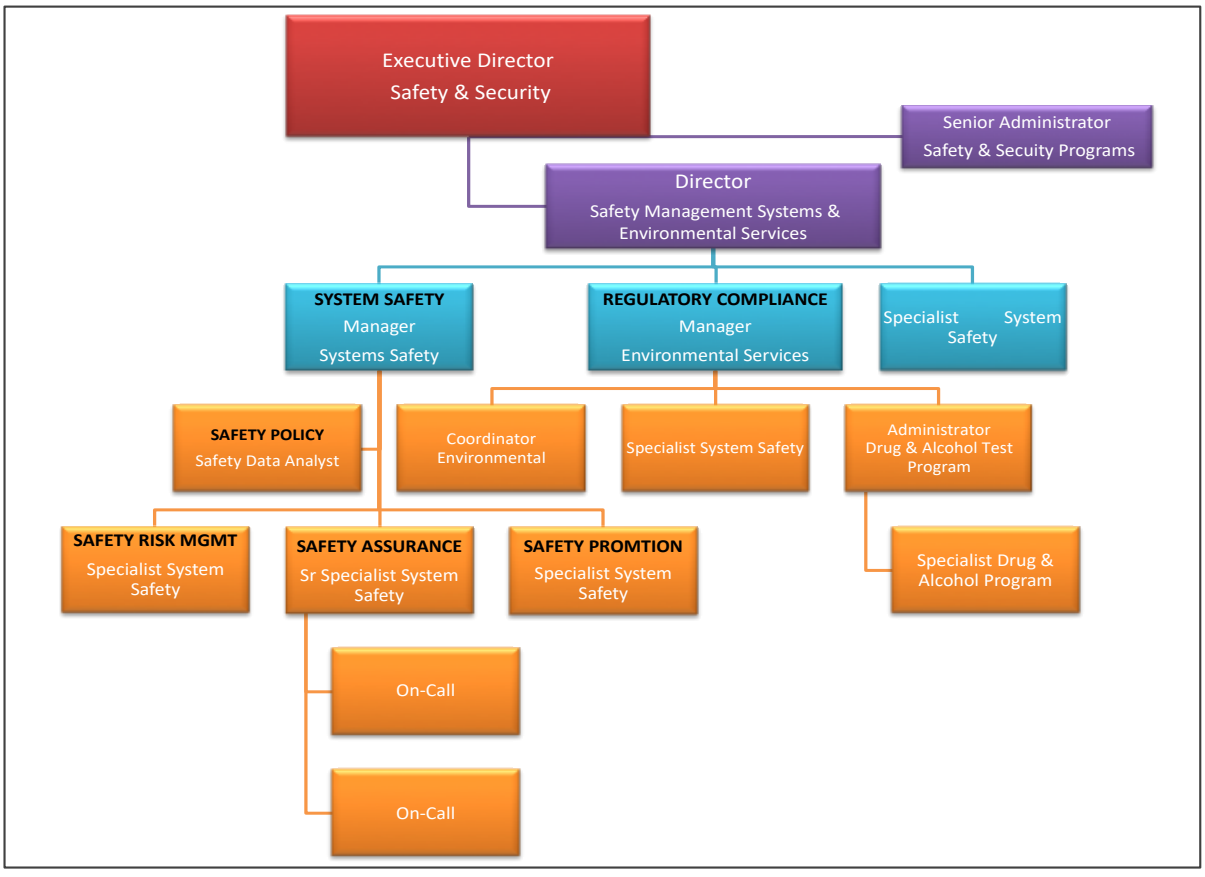


Figure 3: Proposed Executive Direct Level Safety and Security Organizational Chart

1.4.2. Duties and Responsibilities of Key Leaders

The responsibilities at each organizational level are outlined as follows:

- **General Manager –** is vested with the primary responsibility for the activities of the District. The General Manager has delegated authority to the Chief Operating Officer for carrying out the Public Transportation Agency Safety Plan for TriMet.
- **Chief Operating Officer –** is the Accountable Executive for the TriMet System Safety Program and responsible for the District's overall safety activities and performance. The COO is responsible for ensuring that the SMS is effectively implemented and resourced throughout TriMet and for ensuring action is taken, as necessary, to address any degradation in safety performance. The COO has designated the Safety, Security and Environmental Services Division (SS & ES) as the District's Chief Safety Officer (CSO) with the responsibility for overseeing and implementing safety strategies at TriMet.
- **Executive Directors** - are responsible for upholding and advancing safety policies, developing safety performance objectives, and for holding department directors and managers accountable for the safety performance within their respective divisions.
- **Executive Director of Safety and Security (EDSS)** - the District's Chief Safety Officer, has overall responsibility for overseeing safety strategies and implementation at TriMet. This includes responsibility for implementing TriMet's Safety Management System (SMS). The EDSS is required to be appropriately trained for the position, and have responsibilities that include:
    1. Development and implementation of the SMS processes
    2. Delivery of SMS Training at all levels of TriMet
    3. Development and implementation of SMS Worksheets and tools
    4. Ensuring a Job Hazard Analysis is performed for "high/medium risk" tasks.
    5. Reviewing identified safety risks to verify the risks are properly prioritized using the established Risk Matrices.
    6. Collection and management of Safety Risk Data
    7. Ensuring the Executive Directors are informed of Safety Risks categorized to be outside TriMet Risk Tolerance.
    8. Ensuring the Accountable Executive is informed of all unacceptable risks that require additional resources to reduce the risk to its lowest practicable level.
    9. Establishing and managing methods to collect and analyze safety risk data through risk management strategies.
- **Department Directors and Managers** - are directly accountable and responsible for safety performance within their functional area. This responsibility includes determining and implementing countermeasures necessary to control safety risk and operational conditions that negatively affect TriMet's safety performance.
    1. Identify risk associated with organizational failures including but not limited to policies, procedures and training.

2. Ensuring compliance to SMS processes.
3. Review Hazard Analysis Worksheets submitted by Supervisor.
4. Provide direction and/or additional resources to manage, monitor, and control safety risks within their functional area.
5. Conduct periodic "Open Safety Risk" meetings to discuss:
    a) Effectiveness of corrective actions implemented/reinforced
    b) Review supporting data and documentation
    c) Review progress of corrective actions in progress
    d) Communicate hazard analysis findings.

- **Supervisors and Assistant Managers -** are accountable and responsible for the safety performance of personnel and equipment under their supervision, implementing and maintaining control measures, completing the Hazard Analysis Worksheet for hazards that are identified in their functional area, including but not limited to, equipment and workplace conditions, and:

    1. Submitting the Worksheet to Safety for review and input,
    2. If the hazard rating is within TriMet's defined "tolerable" level, then a supervisor or assistant manager will reinforce or implement corrective action with in their sphere of authority and department capability (resources). This includes:
        a) Investigating additional feasible corrective measures to reduce the risk.
        b) Engaging frontline employees in brainstorming sessions during pre/post work meetings to solicit input and recommendations.
    3. If the hazard rating is within TriMet's defined "tolerable" region, but additional corrective actions are outside the authority of the supervisor or assistant manager or department capabilities, the supervisor will engage:
        a) Peer supervisors to determine if the identified hazard is systemic,
        b) Next level of management for collaboration and decision making;
        c) The Safety Department for professional technical consultation.

- **District Personnel** - personnel are responsible for:

    1. Performing their work safely,
    2. Following procedures and rules,
    3. Reporting circumstances and conditions that may adversely impact safety performance
    4. Reporting mishaps and incidents to their supervisor or assistant manager

Employees are strongly encouraged to use the RSA process and actively participate in opportunities to advance the District's safety efforts, such as serving on safety committees and safety-oriented continuous improvement teams and task forces.

1.4.3. Safety Accountabilities and Responsibilities Matrix

A responsibility assignment (Responsible, Accountable, Consulted and Informed -RACI) matrix describes the participation, by various roles, in completing tasks or other deliverables for a project or business process. The acronym RACI is derived from the four key responsibilities typically used on projects, listed below:

R - Responsible	Those who perform work to complete the task. There is at least one role with a participation type of responsible. Others can be delegated to assist in the work as necessary.
A - Accountable	The person accountable to complete the deliverable or task. This person ensures the requisites of the deliverable are met and delegates work to others, as applicable. Accountability cannot be shared; therefore, only one person may be specified in this role for each deliverable.
C - Consulted	This role is for subject matter experts (SMEs) who have crucial expertise and experience in their respective fields. SMEs must be consulted as early in the decision-making process as possible and provided access to all relevant materials. SMEs are active participants and must be kept in the loop. The SME role can be assigned to multiple people, as needed and in accordance with their areas of expertise.
I - Informed	Those who are kept updated on the progress and completion of the deliverable.

Table 1: RACI Matrix

Safety Tasks and Activities	General Manager	COO	Transportation Exec Dir	Maintenance Exec Dir	Rail and Bus Trans Mgr	LRV and Bus Maintenance	Rail MOW Manager	Field Opns Mgr	Facilities Director	Engineering & Construction Exec	Contracts & Proc Director	HR / Labor Exec Dir	Internal Audit Manager	Safety & Security Exec Dir
Goals & Objectives	-	A	C	C	C	C	C	C	C	C	C	C	-	R
ASP Control & Update	-	A	C	C	C	C	C	C	C	C	C	C	-	R
Hazard Management Process	I	C	R	R	R	R	R	R	R	R	R	-	-	A
System Modifications	-	A	R	R	R	R	R	R	R	R	I	-	-	C
Safety Certification	-	C	R	R	-	-	R	-	R	R	-	-	-	A
Safety Data & Acquisition	I	A	R	R	R	R	R	R	R	-	-	-	-	R
Accident Notification, Investigation & Reporting	-	A	R	R	R	R	R	R	R	R	-	-	-	R
Emergency Management	-	A	C	C	C	C	C	C	C	C	-	-	-	R
Internal Safety Audit Process	-	A	C	C	C	C	C	C	C	C	C	-	R	R
Rules Compliance	-	A	R	R	R	R	R	R	R	-	-	-	-	C
Facilities & Equip Inspect	-	A	-	R	-	R	R	-	R	C	-	-	-	C
Audits &Inspections	-	A	R	R	R	R	R	R	R	C	-	-	R	R
Training & Certification Program	-	A	R	R	R	R	R	R	R	-	-	C	-	R
Configuration Management	-	A	R	R	R	R	R	R	R	R	-	-	-	C
Local, State & Federal Req	-	A	R	R	R	R	R	R	R	R	I	R	I	C
Hazardous Materials	-	R	-	R	-	R	R	-	R	I	I	-	-	A
D & A Program	-	A	R	R	R	R	R	R	R	-	R	R	-	R
Procurement	-	R	R	R	R	R	R	R	R	R	A	-	-	C
Hours of Service	-	A	R	R	R	R	R	R	-	-	I	I	-	C

R = Responsible; A = Accountable; C = Consult; I = Inform

1.5. Safety Policies

A series of policies have been developed to guide the safe operation of TriMet. A full listing of the policies is provided on TriNet.

1.6. TriMet Safety and Security Related Committees

TriMet departments maintain a variety of safety and security-related committees, which may be composed by function or location, depending on scope and focus. These include:

- Transit Change Review Committee
- Fire/Life Safety, and Security Committee
- Workplace Safety Committees
- Safety and Security Committee
- Vehicle Accident Review and Appeals Board
- Continuous Improvement Teams

1.6.1. Transit Change Review Committee (TCRC)

The Transit Change and Review Committee (TCRC) is the formal committee established to assure the process safety management of change within TriMet. This committee is tasked with review (for consideration and communication) and/or approving changes that may have an impact on TriMet's safety and security performance.

The TCRC responsibilities are focused on monitoring changes in the risk environment (investigations, audits, and data analyses), and management of change for the safety and security programs at TriMet, including:

- Safety and Security Certification (major and non-major projects)
- System Modification (including bus and rail vehicles, signals, communications, and traction power)
- Facilities and Infrastructure Modification (including pedestrian crossings, platforms, stations, and stops)
- Procurement (including safety and security requirements)
- Configuration Management (as the formal committee).

More information about TCRC's scope, activities, membership, and communications is available through its Charter.

1.6.2. Fire/Life Safety and Security Committee

The purpose of the committee is to identify and work through issues related to the new rail extensions; a committee is formed for each new start. The committee develops lists of potential issues related to the project and identifies mitigations and solutions to those problems or issues.

Currently the committee is comprised of stakeholders affected by the project, as well as assisted by members of the TriMet Engineering & Construction team assigned to various segments of the alignment. These stakeholders may include representatives from the City of Portland, Sheriff's Office, Fire & Rescue,

TriMet departments including Transit Police, Operations Support, Field Operations, Rail Transportation, Maintenance of Way, Rail Equipment Maintenance, Facilities Maintenance and Community Relations.

1.6.3. Workplace Safety Committee

In accordance with Oregon Administrative Rule 437-001-0765, TriMet's maintains workplace safety committees organized by location or function. The purpose of these committees is to bring management, employees, employee representatives, and SMEs together to communicate and evaluate safety and health issues to ensure that the District maintains a safe, healthful workplace.

TriMet employees can bring safety items to the attention of the committees in person or submitting a Request for Safety Assessment (RSA) via TriNet or during safety committee meetings. The committee has the option of handling action items within the committee or having it formally addressed at TCRC or the Rail Operations Rule Committee.

1.6.4. Safety and Security Committee

The purpose of the Safety and Security Committee is to assist in the detection and elimination of unsafe conditions, and work practices that may lead to accidents and injuries to the public as well as TriMet employees.

A committee is created for each new rail extension. Members of the committee include the Project Manager, Operations Support, Rail Transportation, Safety Department and Maintenance of Way. External stakeholder agencies may be invited to participate as needed.

More information about these committees, including scope, activities, membership, and communications is available on TriNet at: https://trinet.trimet.org/home/divisions/safety-security/safety-dept/safety-committee-reports/safety-committee-reports-1

1.6.5. Rail Operations Review Committee

ROR Review Committee is responsible for the development of new rules and procedures as well as changes to existing operating practices. ROR ensures processes comply with federal, state, and local regulations. The objectives of ROR are to:

- Develop and maintain the process for approval and implementation of changes for all rail operating rules, Standard Operating Procedures (SOPs) and related documents.
- Review safety data trends (Including reports of incidents, accidents and near miss/ close calls) and identify procedural gaps in rules, SOPs and related documents.
- Review proposed changes to rail operations rules for effects on other existing rail operations rules and SOPs, and related documents to ensure regulatory compliance.
- Identify requirements for the change management and implementation process including communication, distribution plans, documentation of the process, training coordination, and document management and storage.
- Develop and ensure compliance with an established standard that governs the definitions, formats, and specific roles of all rules, SOPs, and related documents.

- Lead regular and periodic comprehensive reviews of all SOPs, rules, and related documents at regular intervals resulting in the publication of an updated document to include Rail Operating Rulebooks.

1.6.6. Vehicle Accident Review and Appeals Board

The District supports activities that help identify opportunities for continuous improvement, which is the foundation for forming these boards. Their purpose is to critically evaluate vehicle-related events and decide whether the employee-operator could have prevented occurrence or mitigated the resulting severity by use of defensive driving strategies and techniques. These boards are made up of frontline operators, Transportation management, Risk Management, and the Safety Department. Third step appeals are performed by an independent third party. This is done to assure these processes meet the intent of published guidelines on prevention of incidents and accidents of TriMet busses and light rail vehicles. These boards are an independent process and focus solely on preventability.

There are two accident review boards that are divided by mode and follow guidelines published by the National Safety Council on accident preventability. Events involving over-the-road vehicles (e.g., buses, service trucks, and passenger vehicles) are subject to review by the Bus Accident Review Board. Events involving vehicles that operate on the light-rail system are subject to review by the Rail Incident Review Board. Affected employees do not participate in the review boards processes nor are the boards aware of the identities of the affected employees.

Employees who receive a determination of preventable accident may elect to appeal the review board's decision to a separate board. There are two appeals boards, which reflect the same division by mode as the review boards. The affected employees actively participate in the appeal and are encouraged to provide additional relevant materials supporting their knowledge and understanding of the event.

Employees whose determination of preventable accident is upheld by an appeals board may elect to appeal the decision to an external reviewer whose decision is final. More information about these boards is available by going to the accident review and appeals policy and operations manual.

SMS Component II – Safety Risk Management

Safety Risk Management (SRM) is a formalized, proactive approach for driving TriMet's continuous safety efforts. SRM provides the structural elements and guides program development necessary to ensure hazardous conditions are identified, assessed for risk level, and safety risk is mitigated to an acceptable level, throughout TriMet's operations.

Identification of hazards shall be a continuous effort performed across all operational areas. Evaluating hazards and incorporating mitigation controls reduces the overall risk to TriMet and improve its ability to provide quality service and performance throughout the communities we serve. Moreover, it provides a framework to ensure that once a change is made, it is tracked and continually improved upon throughout its lifecycle.

Safety Risk Management, however, does not mean the elimination of all safety risks. For example, a rail system with at-grade highway-rail or pedestrian grade crossings cannot eliminate the safety risk at those crossings. Similarly, a bus system cannot eliminate the safety risk involved with roadway intersections. However, using the SRM process, hazards to persons or property may be minimized to an acceptable level through various controls. This process involves identifying, reporting, evaluating, and mitigating work place hazards and close call/near misses incidents. Once identified and reported, the hazard is evaluated, corrected or mitigated by implementing design changes, installing safety devices, installing warning devices/signage, or changing work practices/work procedures to provide a level of safety that is practical with the available resources of the agency.

The strategies for implementing controls are dependent on whether an identified hazard and its associated safety risk pertains to the operational, design, construction, or renovation phase of the TriMet system.

A foundational element of the Safety Management System is risk ownership, meaning that each department owns the hazards associated with its operations and, as such, must actively manage efforts to address and control those hazards. To ensure effective risk management, each of TriMet's departments will maintain a hazard log with risk rankings; a tab for key personnel to contact in the event of an emergency; hyperlinks to standard operating procedures (SOPs) with safety implications; and JHA's for high-risk jobs performed by department personnel.

2 Hazard Identification

The first step in the SRM process is to identify hazards within our system. Safety hazard identification involves establishing methods or processes to identify hazards and consequences of the hazards to address them before they escalate into incidents or accidents. It also provides a foundation for the safety risk assessment and mitigation activities that follow.

At TriMet, our objective is to cultivate and foster a safety culture in which employees are comfortable and encouraged to bring safety concerns to the attention of management. We recognize that our employees are the ones who most intimately familiar with the details of their job and their work environment, which make their input crucial to maintaining safety in the workplace.

TriMet's employee reporting system includes a process that allows employee's including contractors the mechanism for reporting safety conditions to senior management. This process provides protections for employees and contractors.

Therefore, when witnessing an unsafe act or noticing an unsafe condition, employees and contractors are obligated to promptly report the unsafe condition or unsafe act to their direct supervisors, managers, the Safety Department, and/or the safety committee representatives, and should receive a clear answer with a corrective action plan as appropriate. Similarly, near miss and close calls – events that could have resulted in an injury but did not like an avoided collision or a narrow escape from a dangerous situation are a key part of the hazard identification portion of the employee reporting system.

No person will be penalized or retaliated against for bringing safety issues to the attention of management. If the employee or contractor's behavior is considered immediately dangerous to themselves, their co-workers or the public some disciplinary action may need to be taken to ensure the safety of the system. Employees and contractors can report anonymously.

There are several ways employees can report safety concerns:

- Report directly to their supervisors or managers,
- Report through the Safety Committee Representatives,
- Report through the Communication Center
- Submit a request using the online, electronic reporting system
- Report directly to the Safety Department,

Safety concerns and comments are reviewed and follow up by the direct supervisors, managers, and the Safety Department in a timely manner.

TriMet is implementing an online electronic reporting system available to all employees. Any employee can submit a report. This in turn provides a consistent process to record, track and trend hazards and prompts safety committees and management teams to provide a response back to the submitter.

After a hazard is reported the responsible department shall conduct an investigation, document the results of the evaluation, approve the mitigation, monitor the mitigation to completion and close the incident. The SSE Division is a resource to the responsible department and will report those hazards to SSOA that meet the threshold for regulatory oversight.

The employee is responsible for checking the status of their incident call via the assigned incident number that is provided once the hazard is reported. Additionally, TriMet has the following hazard identification methods in place, which are further described in **the reference section.**

Formal Hazard Identification Sources	Additional Data Sources
○ Preliminary Hazard Analyses (PHA) ○ Subsystem Hazard Analysis (SSHA)	○ Employee reporting system (ERS) ○ Requests for safety assessment (RSA) ○ Operator observations

○ Operational and Support Hazard Assessment (O&SHA) ○ Failure Modes, Effects, and Criticality Analyses (FMECA) ○ Fault Tree Analyses ○ Software Safety Analysis (SSA) ○ Security Analysis (SA) and Threat and Vulnerability Assessment (TVA) ○ Job Hazard Analyses (JHA)	○ Maintenance reports ○ Reports from drills, exercises, and emergency response to incidents ○ Inspection results ○ Internal safety investigations ○ Accident and incident reports ○ Compliance programs ○ Committee reviews ○ Industry data and Governmental sources (FTA, NTSB, oversight agency) ○ Customer and public feedback or complaints

Training employees on proper hazard identification techniques, risk-ranking training and using comprehensive data sources increases the likelihood that hazards can be adequately defined and evaluated. Which, in turn, enables management to be more confident about allocating resources, planning and directing efforts to adequately address hazards, and ensure continuous operational improvement.

2.1.1. Hazard Tracking

While tools exist to quantitatively evaluate risk (e.g., probabilistic or statistical analysis), the risk assessment methodology is often based on a qualitative calculation of subjective judgments used to determine the risk associated with each hazard. Potential hazards identified through the risk assessment process are classified for impact (i.e. severity) and likelihood (i.e. probability) as illustrated in **Tables 2** and **3**. Impact categories provide a qualitative measure of the most reasonably credible outcome that might result from an event.

Hazards that require risk mitigation to bring them to acceptable levels are tracked in a hazard log. **Reference section** provides an example of a typical hazard log format utilized by TriMet. The hazard log is divided into four (4) general sections:

1. Hazard Tracking Information
2. Initial Findings
3. Recommendations
4. Resolutions

Table 2: Hazard Severity Rating System

Severity	Characteristics			
	People	Equipment/ Services	Financial	Reputational

Catastrophic I	Several deaths and/or numerous severe injuries	Total loss of equipment or system interruption, requiring months to repair	Estimated loss from the incident in excess of $5 million	Ongoing media coverage, irreparable reputational damage, government intervention Weeks - Months
Critical II	One death and/or several severely injured	Significant loss of equipment or system interruption, requiring weeks to repair	Estimated loss from the incident in the range of $500,000 to $5 million	Prolonged media campaign, serious reputational damage, sustained government involvement Days - Weeks
Moderate III	Severe injuries and/or numerous minor injuries	Some loss of equipment or system interruption, requiring seven or less days to repair	Estimated loss in the range of $ 50,000 to $500,000	Adverse media coverage, reputational damage, government involvement Days
Minor IV	Severe injury and/or multiple minor injuries	Some loss of equipment, no system interruption, less than 24 hours to repair	Estimated losses are relatively minor, in the range of $1,000 to $49,999	Local media coverage and some reputational damage Day
Insignificant V	Minor injuries or No injuries	Minor damage to equipment no system interruption, no immediate repair necessary	Estimated loss from the incident are likely less than $1,000	No adverse media coverage or reputational damage

Table 3: Hazard Probability Rating System

Probability Level	Specific Individual Item	Fleet or Inventory	Frequency
Frequent	Likely to occur frequently in the life of an item.	Continuously experienced.	>36/yea (Weekly)
Probable	Will occur often in the life of an item.	Will occur regularly.	>12 to <36/year (1-3 per Month)
Likely	Will occur several times in the life of an item.	Will occur several times.	>1 to <11/year
Occasional	Likely to occur some times in the life of an item.	Will occur a few times	> .1 to <1/year
Remote	Unlikely but possible to occur in the life of an item.	Possible to occur in the life of the system	>.0001 to <.1/year
Improbable	So unlikely, it can be assumed occurrence may not be experienced.	It can be assumed it will not occur	<.0001/year

2.2. Safety Risk Assessment

Once a hazard has been identified, the next step is to determine the safety risk level associated with the hazard and determine if formal hazard analysis and tracking is warranted. This process defines what will be analyzed, who will do the analysis, examines each identified hazard and determines the conditions under which that hazard exists, and provides clarity for the evaluation of safety risk. Management teams can address the hazards and risks themselves or forward the issues to senior management in some cases.

2.2.1. Hazard Categorization

Hazards identified through formal project hazard assessments - operating system investigations that have resulted in, or have the potential to result in injury, fatality, or system loss; and operating system mishap/incident trend analyses - are categorized through a formal classification system. The hazard categorization system is used to determine the acceptability of assuming a risk associated with a hazard, the necessity of implementing mitigation measures to eliminate or reduce the hazard to an acceptable level of risk. If a hazard determination is found to be one of a systemic nature or present a system wide hazard such as Immediately Dangerous to Life and Health (IDLH) a corrective action plan would thereby be initiated by the SSE Division.

Hazard categorization involves classification of the hazard in terms of severity and probability. The United States Department of Defense's Standard Practice for System Safety, MIL-STD-882E, establishes system safety guidelines for determining hazard severity and probability. TriMet has adapted the Risk Assessment and Hazard Risk Index matrixes for use in its hazard categorization process.

2.2.2. Risk Tolerability Decision Making Process

Hazard categorization may be a subjective determination. Using historical data and root-cause analysis, an objective determination can be derived; leading to enhanced risk mitigation strategy. The risk mitigation strategy must incorporate the most credible outcome that could result if no action is taken.

As such, hazards and associated risk are rated in terms of their effect on TriMet customers, employees, the public, and the operating system. Not all identified hazards will require documented mitigation strategies, and formal hazard analysis. Many identified hazards will be resolved at the user level or first level of management. Formal hazard management activities will be reserved for those hazards (and associated risk) which rises to the level of TriMet's requirement to manage and control these conditions. These thresholds are further detailed in Section 2.2.3 below.

The probability that a hazard will occur during the planned life expectancy of the system element is described qualitatively, in potential occurrences per unit of time, events, population, items, or activity. A qualitative hazard probability is derived from research, analysis, and evaluation of safety data from the operating experience of TriMet or historical safety data from similar systems.

2.2.3. Hazard Risk Index

Together, the hazard severity and probability properties measure a hazard's magnitude and priority for applying the control measures. Hazards are then examined, qualified, addressed, and resolved based on the severity of a potential outcome and the likelihood that such an outcome will occur. The value derived

by considering a hazard's severity and probability is the Hazard Risk Index. The resulting risk index is a measure of the acceptability or undesirability of the hazard and is applied to the Risk Assessment Index.

Safety critical hazards that have been identified must be controlled or eliminated so that the hazard does not continue to pose a danger. The controls may be done in a temporary manner until a long-term mitigation has been implemented. Dependent on the risk ranking of the hazards' likelihood and severity, a multi-departmental team may be established to analyze and control these risks/hazards. The teams may include the following personnel:

- Subject matter experts (SMEs) for the system
- Front-line personnel and supervisors
- All levels of labor
- SSOA participation is encouraged
- Safety staff (as support)

The following matrix identifies the Hazard Risk Index based upon hazard category and probability and the criteria for defining further action based upon that index.

HAZARD RISK INDEX					
Frequency of Occurrence	**Severity Category**				
	1 Catastrophic	**2 Critical**	**3 Moderate**	**4 Minor**	**5 Minimal**
(A) Frequent	**1A**	**2A**	**3A**	**4A**	**5A**
(B) Probable	**1B**	**2B**	**3B**	**4B**	**5B**
(C) Likely	**IC**	**2C**	**3C**	**4C**	**5C**
(D) Occasional	**1D**	**2D**	**3D**	**4D**	**5D**
(E) Remote	**1E**	**2E**	**3E**	**4E**	**5E**
(F) Improbable	**1F**	**2F**	**3F**	**4F**	**5F**

Figure 5: Hazard Risk Index Rating System

2.2.4. Risk Tolerability Non-Consensus Procedures

The primary method for hazard identification of new or revised processes will be through safety committee meetings. Subject matter experts from relevant departments will be involved in these meetings. The hazard log will be updated as information is gathered from incident reports, implementation of mitigation efforts or other changes occur. As part of TriMet's ASP Implementation Plan, TriMet staff will establish an escalation process, in each department, which will identify requirements to notify the Transit Change and Review Committee (TCRC) for review. This process will be managed through the Safety Committee; requiring department management to present known issues and their respective hazard log, and appropriate documentation. A determination will be made if the report needs to be elevated to the TCRC for final evaluation and approval. If the hazard is found to be anything that rises above acceptable without further review, it thereby must be elevated to management and to the TCRC. If the hazard is found to be on of an IDLH condition, or unacceptable, the work should cease and an assessment would be required prior to re-initiation of the task or action.

The TCRC is the formal committee within TriMet, tasked with review (for consideration and communication) and/or approving changes that may have an impact on TriMet's safety or security performance. The TCRC is focused on monitoring changes in the risk environment and management of change for the safety and security programs at TriMet. High risk and systemic hazards are given priority in the TRCR Charter. However, the TCRC Charter allows for safety committees; including project safety committees, to establish risk rankings and prioritize on an as needed basis to review such things as incidents/close calls in order to determine if new hazards may. The TCRC members are responsible for the development and review of proposed changes to:

- Operating Rules
- SOPs
- Configuration of bus or rail equipment, bus or rail systems, and facilities, including those affecting the safety of TriMet operations
- Bus and Light rail vehicles.

Additionally, management reviews trends and KPI's and drives their respective departmental safety issues in partnership with the SSE Division. The management team also evaluates the effectiveness of the Bus and Rail system safety programs and activities and its implementation through the review of safety audits, major incident or accident investigations, and safety related statistics to reduce the potential for recurrence of similar incidents and negative trends.

2.3. Safety Risk Mitigation

Procedures to reduce risk, to the lowest acceptable levels based on mitigation, include actions taken to reduce the likelihood and/or severity of the potential consequences of a hazard. Safety risk mitigation enables a transit agency to "manage" safety risk in a manner that is aligned with its safety performance targets, and consists of initial, ongoing, and revised mitigations. Corrective action plans for insignificant and minor risk incidents/close calls are mitigated at the safety committee level. Moderate, critical and catastrophic incidents/close calls may require formal corrective actions that elevate to the TCRC. If need of a CAP is determined, it will be reported to the SSOA and the risk will be mitigated to ALARP. TriMet will track actions until closure and submit for final approval by the SSOA.

2.3.1. Procedures to Reduce Risk Levels

Departmental hazard logs are to be available for review or for audit purposes by safety committees and to be periodically reviewed at TCRC. The TriMet Safety Committees are the principal bodies for assessing and resolving identified hazards within the TriMet operating system. However, safety risks related to Engineering and Construction (such as rail extensions, equipment procurements and system renovations and upgrades) are reviewed and resolved by the Safety and Security Committee specifically created for the specific capital project.

The TCRC may request additional subject matter experts or persons with the most subject knowledge to complete a formal hazard analysis to demonstrate level of assumed risk(s) or likelihood of occurrence. Per TriMet's Agency Safety Plan, Safety Risks that are ranked must be reviewed by the TCRC for consideration and review. The review will assure additional mitigations are considered and or implemented. The TCRC will review information presented that may be categorized as *Acceptable with TCRC Review*, *Undesirable*, and *Unacceptable*:

- Risks categorized as *Unacceptable* must be addressed immediately to assure a hierarchy of controls is further considered and implemented by the responsible party or group.
- Risks categorized as *Undesirable, Executive Management review required*, must be referred to the Leadership Team. The Leadership Team will provide direction for resolution, which might include approval, referring issue back for further controls/mitigations to be considered and implemented, or both. The final action taken will be presented at the next available TCRC meeting and reflected in the minutes.
- Risks categorized as *Acceptable with TCRC review* must be approved or required to have further control measures/mitigations implemented to lower the risk level further.

Table 4: Strategies to Mitigate Safety Risks

Definitions of Strategies to Mitigate Safety Risks	
1. Elimination or Minimization of the Hazard	Design for Minimum Risk – If possible, the hazard will be eliminated through a design change. If an identified hazard cannot be eliminated, the hazard will be reduced to an acceptable level, as defined by the Risk Assessment Criteria, through design selection. Incorporate Safety Devices – If identified hazards cannot be eliminated or their associated risk adequately reduced through design selection, that risk is reduced to an acceptable level using fixed, automatic, or other protective safety design features or devices. Provide Warning Devices -- When neither design nor safety devices can effectively eliminate identified hazards or adequately reduce associated risk, warning devices are used to detect the condition and to produce a timely warning signal to alert personnel of the hazard. Warning signals and their application are designed to minimize the probability of incorrect personnel reaction to the signals and are standardized within like types of systems.
2. Use of Administrative Controls	Develop Procedures and Training – Where it is impractical to eliminate hazards through design selection or adequately reduce the associated risk with safety and warning devices, procedures and training are used. However, without specific direction from TriMet Executive Management, no warning, caution or other form of written advisory may be used as the only risk reduction method for Category 1 or 2 hazards. Procedures may include the use of personal protective equipment. Tasks and activities that are determined to be critical require certification of personnel proficiency.
3. Use of Personal Protective Equipment	If the hazard cannot be eliminated or adequately controlled with administrative controls, personal protective equipment may be needed. Training on the proper use of the equipment is required prior to employees being placed in an environment requiring such equipment.

The Executive Management Team is advised of Category I and II hazards that cannot be satisfactorily resolved by the Committees or Engineering and Construction Task Forces to an acceptable level for final resolution. As such, Category I and II hazards typically will require TriMet's Executive Management Team to identify additional (sometimes-uncommon) resources to address long-term solutions and/or a significant capital investment.

2.3.2. Evaluation of Current Mitigations

Following the safety risk assessment, TriMet will identify mitigations or strategies that may be necessary to protect our employees, customers, and the public. Examples of risk mitigations include revising the system design, modifying operational procedures, or establishing contingency arrangements.

Once a potential mitigation is determined, TriMet will need to evaluate the potential effectiveness of that mitigation. Not all mitigations have the same potential for reducing the risk from a hazard. The effectiveness of each specific alternative needs to be evaluated before a decision can be made. Safety and departmental SMEs must collaborate in this evaluation process.

2.3.3. Risk Mitigation Implementation and Tracking

The "Final Hazard Rating" indicates the accepted risk levels based on implementing the hazard resolution activities or the resolution that TriMet chose to implement. This is often defined as the "residual risk." Often times the final mitigation measures decided to implement may not be as comprehensive as those initially recommend, but the result is an "acceptable" risk profile. The Hazard Log (an example is found in the reference section) tracks the status of the identified hazards (Initial Finding), as well as the Recommendations and Resolutions. The definitions below explain the sections and purpose of the Resolutions Section of the Hazard Log.

Hazard Category	Each credible hazard is evaluated again in terms of severity and probability after applying the final resolutions/mitigations to determine the new Hazard Category.
Hazard Risk Index	Based upon the updated Hazard Category, an updated Hazard Risk Index is determined after the final resolutions/mitigations are implemented by TriMet.
Assessment Checklist Reference	This section lists the applicable checklists and their corresponding item numbers that were used to conduct the Hazard Analysis.
(Open/Closed)	This column is to indicate if the hazard is open or closed. For a hazard to be classified as "closed," all final mitigations must be implemented and verified to be functioning as intended. This can often be done through inspections or testing.
Date Closed	The date of verification that the risk was mitigated to an acceptable level.
Closure Reference & Notes	This section is used to annotate supporting documentation (e.g., drawings, rules, test results, and procedures) or notes that show the measures taken to lessen the severity and/or probability of a hazard and, thus, support the agency's acceptance of the risk.

TCRC and the TriMet Safety and Security Committees track identified hazards (IDLH or determined to be systemic in nature)—rail transit, bus transit, and occupational health and safety issues, respectively—within the TriMet transit system to final resolution. Hazards related to capital projects, such as rail extensions, equipment procurements and system renovations and upgrades, are tracked through the safety committees created for the projects. The Safety and Security Committee tracks hazards identified in PHAs, design reviews, and safety and security certifications. TCRC, the TriMet Safety Committees, and Engineering and Construction Task Forces maintain logs through the Safety Management Information System (SMIS) that detail resolution activities to date and the status of the hazard— open or closed. Additional information about safety committees can be found in **the reference section**.

2.3.4. Safety Risk Mitigation Ownership

Despite all of these efforts, unless a hazard is eliminated, the risk **still** exists. All risks must be properly documented and continually evaluated. Departmental managers are responsible for the implementation and tracking of mitigation strategies for their department.

SSE Division personnel are responsible for monitoring the effectiveness of mitigation strategies through periodic checks done under the direction of Safety Assurance. Everyone, within TriMet, who interacts with risk mitigation strategies from identification, strategic planning through implementation once they are implemented, must have ownership.

2.4. Safety Data Acquisition and Analysis

2.4.1. Data Acquisition Process

The SSE Division is responsible for assuring the collection, maintenance, analysis, and reporting of safety data, achievements, and problems. The purpose of this activity is to determine the status and trends of safety conditions, and to monitor performance towards the established safety goal and objectives. This activity is accomplished through the following steps:

- Define information requirements and sources;
- Collect pertinent data from TriMet Departments;
- Monitor safety conditions and performance;
- Analyze safety-related data-system failures, accident statistics and accident trends; and,
- Report safety performance, achievements, and problems to the Accountable Executive, Executive Directors, Directors, and other TriMet managers.

2.4.2. Data Reporting to Safety Function

The SSE Division is tasked with monitoring the safety performance of TriMet operations. Safety data is collected and reviewed. This data includes injuries to passengers, TriMet personnel, public, potentially hazardous equipment failures, design inadequacies, and rules and procedure violations. Rail safety-performance reports are submitted to ODOT, TCRC, and the Accountable Executive on a periodic basis. The report contains injury data pertaining to customers, TriMet personnel, and the public from accidents and incidents.

Information regarding accidents, incidents, close calls/ near miss, hazardous conditions and TriMet operations are obtained from several different reporting mechanisms. These include, but are not limited to the items listed in Table 5; this data becomes the basis for the safety dashboards that are available to employees.

Similarly, through the implementation of its Transit Asset Management (TAM) Plan, required under 49 C.F.R. Part 625, TriMet Operations should report the results of its condition assessments while performing safety risk management activities. The results of the condition assessments and subsequent SMS analysis will inform TriMet's TAM Plan elements, specifically investment priorities. The Accountable Executive has the ultimate responsibility for decision-making throughout this data reporting process.

Table 5: Description of Sources

Sources that Provide Input to Accidents, Incidents, and Hazardous Conditions	
Occupational Injury/Illness Reports	The employee and Supervisors complete an Occupational Injury/Illness Report any time a staff member reports a job-related injury or illness. This standard report is completed online and submitted to the SMIS database. These reports are reviewed daily by a member of the SSES. Issues are discussed at safety committee meetings and with management, as needed. Items requiring review may be placed on the agenda for TCRC. The process is outlined in SOP 052, "Reporting Employee Injuries".
The Operations Command Center	The Operations Command Center (OCC) is the information collection center of TriMet. It is composed of two groups: Dispatch and Control. Dispatch monitors and directs bus operations. Control monitors and directs rail operations. All radio communication to the field is made through the OCC. Information concerning day-to-day issues and operation is relayed from the field to the OCC; information meeting predetermined criteria is entered in the ACID database as it is received.
Safety Management Information System Database	This database is used to collect and maintain a wide variety of data at TriMet. Information reported by operators concerning accidents, near misses, rule violations, defects, and property damage is entered into the system. Employees have access to SMIS and can use the system to access information concerning accidents, incidents, security issues, and rules violations. This information is used to: • Make accident notifications to governing bodies; • Send accident/incident information to management; via pager or email; • Send security information to management via pager; • Make decision on accountability for accidents; • Supply maintenance information to maintenance shift Supervisors; • Conduct trend analysis; • Monitor rule and procedure violation.

2.5. Coordination with Regulatory Authorities

Notifications of significant transit incidents are initiated by TriMet's Operations Command Center by e-mail to sso@odot.state.or.us in accordance with the reporting thresholds listed below. The SSE Executive Director (or designee) is the TriMet primary point-of-contact with all external agencies in the event an investigation is initiated by any of the external agencies and for providing updates and additional information, as necessitated by the event. All initial notifications will include the following information:

- Brief description of the incident.
- Internal control number assigned to the incident.
- Casualties – number of fatalities and/or injuries.
- Date, time and location of the incident.

Table 6: Notifications Procedures

Notification Procedures for Each Agency
Notification to ODOT
ODOT is the designated state rail safety oversight agency for the State of Oregon. As such, TriMet will notify ODOT of any rail-related incident that meets any of the following event criteria. All notifications are made immediately by email or telephone. Security reporting thresholds are found in the TriMet Security Management Plan. Some notifications to ODOT include: • A fatality, either at the scene or where an individual is confirmed dead within 30 days of a rail-related incident: • Serious injury to a person or injuries requiring immediate medical attention away from the scene; • Property damage to rail transit vehicles, non-rail transit vehicles, other rail transit property or facilities, and non-transit property that equals or exceeds $25,000; • An evacuation due to life safety issue or security reasons; • Any derailment involving a rail transit vehicle, at any location, at any time, whatever the cause; • A collision between a rail transit vehicle and another rail transit vehicle or between a rail transit vehicle and non-revenue vehicle; • A collision at a rail-grade crossing with an individual on the rail right of way; • Anytime the FRA is notified of an accident as defined by 49 CFR 225.5. Depending on the significance of the event, a follow-up telephone call may be made to ODOT to ensure the on-duty representative has received the necessary information. Within 24-hours after the occurrence of a reported incident, employee injury or rule violation, a status report of the event is submitted to ODOT and contains the following information: • Identification numbers of employees involved in the event; • Hours of service records for the involved employees covering a period no less than 72 hours prior to the incident; • Number of injuries and fatalities resulting from the event; • Probable causal and contributing factors, if determined or suspected; • If the probable cause has not been determined, an update on the status of the ongoing investigation in the causal and contributing factors; • Any additional information obtained or determined, including employee and supervisor reports, applicable train orders, special instructions, operating conditions, and description of equipment involved.
Notification to National Transportation Safety Board (NTSB)
TriMet will notify the NTSB, through the National Response Center (800-424-0201) within 2 hours of an incident involving: • A passenger or employee fatality; • Serious injury to two or more crew members or passengers requiring admission to a hospital; • The evacuation of a passenger train; or • A fatality at a grade crossing. The NTSB will be notified within 4 hours of incidents involving:

- Damage estimated at $150,000 or more in repairs (or current replacement costs) to the railroad or non-railroad property;
- Damage of $25,000 or more to a passenger train including railroad and non-railroad property.

NTSB investigations of TriMet incidents are coordinated by the SSES Executive Director. CAPs that may result from the investigation are entered into the SIMS for tracking to closure.

Notification to FTA

TriMet will notify the FTA within two hours, at CMC-01@dot.gov or (202) 366-1863, any event involving:

- A fatality occurring at the scene or within 30 days following the incident;
- Collisions between a rail transit vehicle and another rail transit vehicle;
- All collisions resulting in substantial property damage, serious injury, or fatality;
- Runaway train;
- Evacuation for life safety reason due to fire, presence of smoke or noxious fumes, fuel leak, electrical hazard, bomb threat, suspicious item, or other hazard that constitute a real or potential danger to any person;
- Derailment of a rail transit vehicle at any location, at any time, whatever the cause;
- Anytime the FRA is notified of an accident as defined by 49 CFR 225.5;
- Serious injuries requiring hospitalization for more than 48 hours, commencing within seven days from the date of injury was received;
    - Fractures of any bone (except simply fractures of fingers, toes, and nose);
    - Causes severe hemorrhages, nerve, muscle, or tendon damage;
    - Involves any internal organ; or involves second-or-third degree burns, or any burns affecting more than five percent of the body surface.

This requirement excludes serious injuries resulting from illness or other natural causes and criminal assaults that are not related to collisions with rail transit vehicles. FTA will be provided with the following information:

- Brief description of the incident;
- Internal control number assigned to the incident;
- Casualties – number of fatalities and/or injuries; and
- Date, time and location of the incident.

All investigations led by FTA are coordinated by the SS & ES Executive Director. CAPs that may result from the investigation are entered into the SIMS for tracking to closure.

SMS Component III – Safety Assurance

The Safety Assurance (SA) portion of the Agency Safety Plan outlines how TriMet implements, measures and reviews processes to ensure that it remains in compliance with established standards. These processes and reports will provide the confidence to TriMet leadership that the organization and system is functioning within an acceptable level of safety management. The audits, inspections, verifications and compliance checks are established to provide assurances that reviews are completed satisfactorily. TriMet ensures safety assurance through efforts in several core areas:

- Safety Performance Monitoring and Measuring
- Internal Safety reviews and audits
- External reviews and audits
- Facility and equipment inspections
- Maintenance Audits and Inspections
- Reporting and coordination with SSOA/ODOT
- Change Management
- Configuration Management
- Safety System Certifications
- Procurement Process
- Continuous Improvement Programs
- Competency Management System
- Field Supervision Observations

3. Safety Assurance Process

Safety assurance includes safety reviews, evaluations, audits, and inspections, as well as data collection, tracking, and analysis. This chapter explains why safety assurance and evaluations are critical to the SMS.

As shown in Figure 5, Safety Risk Management and Safety Assurance are integrated to form a feedback loop supporting the safety management system. Under safety assurance, the following items related to monitoring compliance with and sufficiency of established procedures for operations and maintenance:

- Identification of all safety standards and requirements, both internal to the agency as well as in recognition of any SSOA or FTA safety standards and requirements that must be complied with and assessed for sufficiency.
- Activities for reviewing safety standards and requirements to ensure they are current, effective, and appropriate.
- Activities for conducting safety events to identify causal factors.
- Activities for compliance with operations and maintenance.

Information collected for safety and risk monitoring in the District includes operations and maintenance (O&M) data, audit and accident investigation results, and training records and information. Depending on their nature, problems discovered during monitoring may be addressed immediately within Safety

Assurance or referred to SRM for formal risk assessment and determination of controls or mitigations. In general, non-conformances are addressed within Safety Assurance, and new hazards and problems are referred to SRM.

3.1. Safety Performance Monitoring and Measurement

SMS performance monitoring and measurement at TriMet involves ongoing collection of safety data metrics to ensure that key safety goals are achieved. Some departments are utilizing job hazard analysis. Development of Safety Assurance will include further defining audit cycles and criteria that determine which elements are subject to this. Each TriMet function and department will determine through hazard identification, risk reduction efforts that safety critical elements may be subject to evaluation and verification. Once defined, any findings of non-compliance will be subject to CAP creation and verification until closure.

3.1.1. Internal Safety Review Program

The purpose of the internal safety review program is to inform management if programs and activities are meeting planned and published safety program requirements and objectives are met. Audits are authorized by TriMet management to verify program compliance with requirements and policies. The process, maintained by the SSE Division, is outlined in the Internal Safety Audit Process (ISAP) document, which is available on TriNet and more details can be found in **References.**

TriMet SSE Division or a designated Contractor conducts system safety audits as random or scheduled events. The SSE Division's Director is responsible for the audits to determine if TriMet's departments are performing specified safety functions. Each audit area is reviewed at least once every 3 years and audits are primarily intended to evaluate systemic risks and hazards. An audit schedule is prepared for the 3-year cycle by the SSE Division and TriMet's internal audit department. ODOT is notified of these audits 30 days in advance and may elect to participate. Additionally, copies of checklists and procedures used for internal audits are submitted to ODOT at the time of the notification. Audits that cannot be conducted by the SSE Division, due to conflict of interest, are performed by the Internal Audit department or a consultant. Following ODOT's revisions to its State Safety Oversight Program Standard (SSOPS) and as part of TriMet's ASP Implementation Plan, the internal auditing process will be revised and updated to reflect the new internal auditing schedule. A detailed audit schedule, per 49 CFR Part 673 and ODOT's SSOPS will be developed and specified in **References**

The scope of internal safety reviews will be on configuration plan management, rules compliance the remaining review topics will be outlined in Oregon Administrative Rules and focused on execution, implementation and effectiveness of the ASP. Some flexibility will be allowed for safety risk management activities that TriMet determines need additional follow-up based on implemented mitigations.

Annually, TriMet will perform a review of its ASP and make revisions as needed. After the review, and upon a date agreed to by the SSOA, TriMet will submit the plan, along with written documentation and any checklists used, to the SSOA for its review and approval. The submittal will include a cover letter identifying any changes made to the plan. If the SSOA advises in writing of any additional changes needed, TriMet will resolve any gaps in a timely manner.

3.2. Corrective Action Plans and Process

CAPs may be generated from the results of audit findings of non-compliance, inspections, systemic or IDLH hazards and accidents.

The SSE Division may review incident reports and available data to seek to trend for potentially serious accidents or hazardous conditions. When data indicates adverse trends in the District's ability to meet or exceed its safety goals and objectives, the SSE Division may investigate and or conduct a hazard analysis to determine causal factors. The SSE Division will coordinate with affected departments to determine corrective actions. The affected departments will be responsible for development and enter their corrective action plans (CAP) in to the SMIS database for tracking and updating action through resolution. If appropriate, the CAPs may also be entered into their respective safety committees' meeting minutes. Higher risk or severity concerns must be elevated to TCRC for review and input. The affected departments will enter any CAPs developed through TCRC's activities into the SMIS database.

The plan includes a description of the findings, the planned corrective actions (recommendations), target completion date, actual completion date, and person responsible for completing the corrective action. When a corrective action is completed, and documentation is submitted to demonstrate completion, it is entered into the SMIS database.

Any incident of concern may be brought to safety committee for further discussions and agreements. Corrective actions, if any, are tracked to completion through safety committees and a formal Corrective Action Plan (CAP) is developed for catastrophic (level 1) and critical (level 2) by the department/unit audited can be brought to TCRC and also tracked to completion in the SMIS data base. The log includes a description of the concern, corrective action(s), the date of evaluation, the person responsible for action, the hazard resolution matrix evaluation, the approval and closing dates. The log is reviewed and updated monthly at the safety committee meetings and for formal Corrective Action Plans (level 1) and critical (level 2) at TCRC meetings within both committees items are tracked until completed. The CAP process provides an opportunity to approve and verify that corrective actions from FTA, SSOA or internal audits are closed out in a timely manner.

3.2.1. Reporting and Coordination with ODOT

When a reportable incident or condition involves post-accident inspections, examination, or testing, ODOT is notified so that it may participate in the investigation. ODOT may elect to conduct a separate, independent investigation. However, ODOT has given TriMet authority to conduct investigations on their behalf. The final investigation reports must be submitted to ODOT for review and approval.

A monthly summary report is submitted to ODOT of all incidents, which meet the reporting criteria, within 30 days from the last day of the month covered. An annual report of TriMet safety performance is submitted to ODOT each February.

3.3. Change Management

TCRC was established to assure a process in place throughout the agency to monitor proposed changes and modifications to existing bus and rail systems safety baselines. Any additions, modifications, or deletions to Bus or Rail Operations SOPs; or the existing safety configuration of operating bus or rail system fixed facilities, rolling stock, or equipment directly related to operation of rolling stock, are reviewed and approved by department management and submitted to the TCRC for review and approval as needed, or if a hazard analysis determines need for additional corrective actions. These

reviews are established to ensure that system and operational changes are approved, prior to implementation, and those drawings, manuals, and other related documents, including training programs, are updated to reflect these changes. Specifically, committee members are responsible for the development and review of proposed changes to:

- Operating Rules;
- Policies
- SOPs;
- Configuration of bus or rail equipment, bus or rail systems, and facilities, including those affecting the safety of TriMet operations;
- Bus and Light rail vehicles.

TCRC may also recommend changes to bus and light rail training programs, as identified through trends, incident reviews, audits, and other assessments. Members include the SSE Executive Director (Chair) or their designee; the Director of Facilities Management; Director(s) Bus and Rail Transportation, Director Maintenance of Way, Director(s) Bus and Rail Equipment Maintenance; the Field Operations Manager; the System Engineering Manager and the SSE. All members participate in the evaluation of changes and must reach consensus. Technical experts may attend committee meetings to clarify proposed changes. ODOT, as the designated safety oversight agency, is an ex officio member of TCRC.

Additionally, the TCRC evaluates the effectiveness of the Bus, Rail and Engineering and Construction, system safety programs and activities and its implementation through the review of safety audits, major incident or accident investigations, and safety related statistics to reduce the potential for recurrence of similar incidents and negative trends. Major safety or security incidents include any incident that has potential for significant liability of TriMet, results in significant, sustained, or unusual disruption of transit service, results in death or serious injuries to persons on TriMet premises or vehicles and/or has potential for high public/media interest or controversy.

3.3.1. Configuration Management

The primary purpose of configuration management is to ensure that potential hazards are identified and assessed before making changes to documents, equipment or facilities. Safety critical operational documents, bus and rail fixed facilities, revenue and non-revenue vehicles, and equipment are subject to configuration management and formal document control procedures. They include, but are not limited to, standard operating procedures, emergency operating procedures, safety and operating rules, training materials, drawings, and engineering reference information. These documents may be subject to review or revision because of:

- Repeated service failures as indicated on the service log in SMIS;
- Incidents or Accidents;
- Major service changes, excluding routine schedule adjustments;
- Line extensions;
- Accumulation of special instructions or notices, which warrant revision to a “parent” document; and
- Proposed design changes to facilities, equipment, or vehicles.

All proposed changes, including deletions, are subject to review and approval by TCRC. Additionally, any member of the TCRC may request a formal review of an operational document, process or procedure at any time. TCRC includes representatives of MOW, Rail Transportation, Rail Equipment Maintenance,

Facilities and SSE Division. These managers and Supervisors inform their staff of all changes. Affected employees are notified of changes as follows:

Changes to SOPs – All changes are sent to Road/Rail Supervisors, Operator and Controllers via e- mail with a delivery receipt. Bus Operators are notified of SOP changes in a "Training Bulletin" with their paychecks. Minor route changes are included in the Operators pouch. All SOPs are posted on TriNet and readily available to any employee. Changes to Rail Equipment Maintenance procedures are sent by e-mail to maintenance employees. Rail Rule Book updates are printed and given to all Road/Rail Supervisors, Rail Maintenance staff, Maintenance of Way Employees and Rail Operators by their managers and Supervisors.

Training - Employees receive training for major system changes, such as rail extensions, in training campaigns or in routinely scheduled training classes. Additionally, configuration management requirements are included in all contracts to assure that changes to the design of equipment and facilities, after design reviews, are adequately documented and approved. The configuration management process uses baseline management to ensure that the technical baseline is defined and controlled throughout the contractual phase, and that the products satisfy the technical and operational requirements derived from the system needs. Selected documentation, such as record drawings, manuals, procedures, and other documents, is formally designated and approved as part of the technical baseline and are initially under the control of the Capital Project Division. Upon completion of each rail extension or phase, all documents related to the operation and maintenance of the segment/phase is turned over to Rail and Bus Operations and Maintenance, as required.

Configuration Control Procedures – All changes are assessed to assure that modifications to facilities, hardware, and operating and support systems are not made without the review of the new configuration by all departments/offices affected by the proposed change, and to ensure that the modified system meets all approved safety requirements. Details of the configuration management process are found in the TriMet Configuration Management Plan and taxonomy is located in the **References**.

If a proposed project change or change in the risk environment identified in a hazard assessment is expected to affect the safety of the system, it is necessary to conduct additional safety analyses and document the results from the safety analyses prior to implementing the change. Even when a change is proposed to improve safety performance, the need to conduct further safety risk/hazard analysis is necessary to ensure that additional risk is not introduced based on the change. The level of analyses in SRM varies by the type of change.

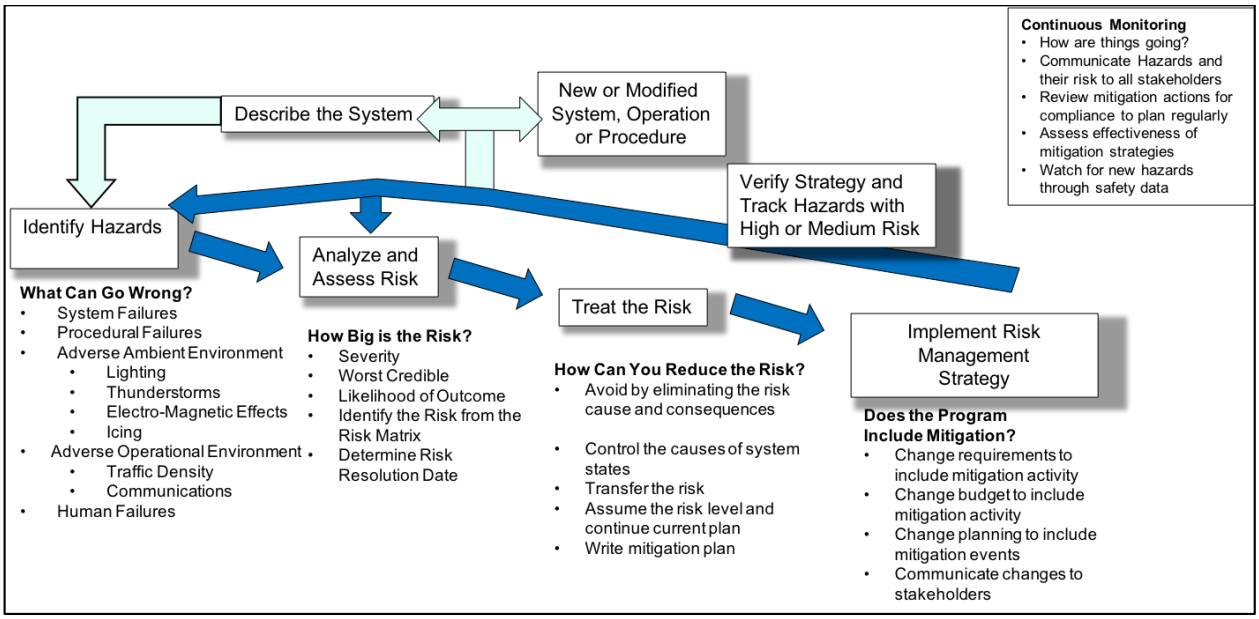


Figure 6: SRM Change Evaluation Process

As shown above in Figure 6, the SRM Change Evaluation Process generally includes the listed steps and should include appropriate subject matter experts (SMEs) within TriMet or external resources, as needed. Introduction of new technologies or systems to make improvements in operations or safety performance must be prioritized and properly evaluated along with other traditional projects and/or procurements. The prioritization of these system changes should be influenced by the importance or need from a safety performance perspective. The SRM Decision Process illustrated below in Figure 7 is used for determining what type of safety analysis is required. Proposed changes to the following categories will require a safety analysis:

- Modifications to revenue vehicle critical safety systems (e.g. brakes, steering, propulsion)
- Changes to safety procedures and standards, including:
    - New operating procedures
    - Waivers to existing procedures, requirements, or standards
- Changes to equipment that impact safety, including:
    - Introduction of new equipment, systems (hardware and software) that impact safety, human-to-system interfaces, or facilities

Modifications to systems (hardware and software), maintenance activities associated with those systems, human-to-system interfaces, or facilities used in providing ABS and navigation services.

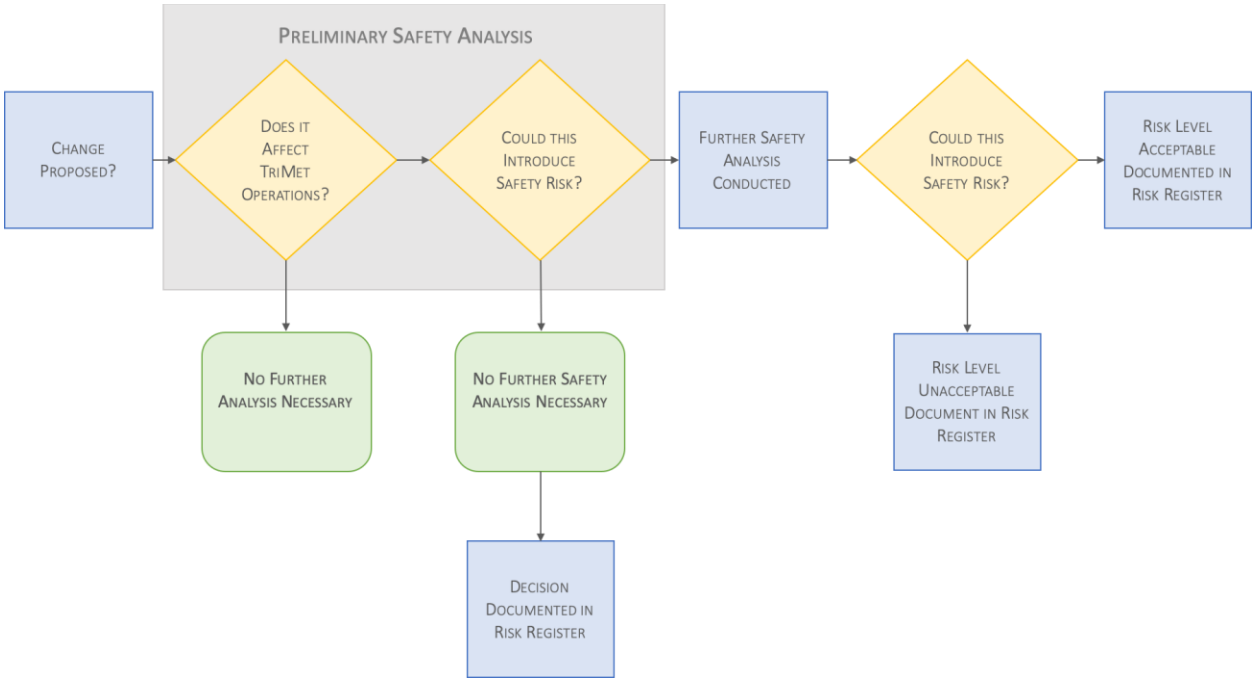


Figure 7: SRM Decision Process

3.4. System Safety Certification

TriMet, as the operator of the light rail transit line, self-certifies that subsequent extensions, new starts and rail phases are operationally ready to enter safe revenue service. A safety and security certification program is developed and implemented for each subsequent operating segment and phase. Some Engineering and Construction projects will complete a safety certification review if required by federal requirements. Detailed information concerning safety certification is provided in the TriMet Safety and Security Certification Plan (SSCP) for each segment. The safety and security certification process also applies to major projects to rehabilitate or modify the existing system. These projects would include:

- Purchase of new rail vehicles, including high rail vehicles;
- Construction of new facilities;
- Modification of existing MOW systems;
- Additions and modifications to the platforms and pedestrian crossings.

System Safety Certification Process Goals and Objectives
Goals
• Verify that identified safety requirements have been met; • Provide evidence that the new operational segments/phases are safe to use in revenue service.

Objectives
• Facilities and equipment have been constructed, manufactured, inspected, installed, and tested, in accordance with safety requirements in the design criteria and contract documents; • Operations and maintenance procedures and rules have been developed and implemented to ensure safe operations; • Training documents have been developed for the training of operating personnel, and emergency response personnel; • Transportation and maintenance personnel have been trained and qualified/certified; • Emergency response agency personnel have been prepared to respond to emergency situations in or along the TriMet light rail right of way; • Safety related system integration tests have been conducted; • All security related issues have been addressed and resolved as specified in the SMP. • Emergency management related issues have been addressed and resolved as specified in the EMP.

Prior to the design and construction phases of a contract, a decision will be made with input from the SSE Division to determine if certification of designed and constructed features of the project need to undergo the safety and security certification process. Some projects will not rise to the level of requiring a full system safety certification. In such cases, hazards/risks and controls are evaluated through an analysis of the Certified Items Lists (CIL). Higher risk projects may require specific hazard assessments, TVA and OHA's. This is particularly true for instances involving federal dollars, and may trigger the need for additional oversight requirements and hazard control programs.

3.4.1. Certification Process

An outline of the certification process used for new starts or additions to the existing system is shown below. The process begins with system design and continues through the start of revenue operation.

1. Identify those safety and security related elements to be certified;
2. Establish Safety & Security Design Criteria;
3. Create Certifiable Items Lists;
4. Prepare the Specification Conformance Checklist;
5. Perform testing and verify conformance;
6. Manage Integrated Testing;
7. Resolve all open items;
8. Approve completed checklist and issue Project Safety & Security Certificate.

The Design Criteria is established by Engineering and Construction and is based upon codes, requirements and best practices. The Certifiable Items List (CIL) and the Specification Conformance Checklists are created and tracked to completion by the Resident Engineer for each project with the assistance of the Safety and Security Committee. Testing is completed by the Resident Engineers and their contractors with oversight by members of the SSE Division and the SSC.

An Integrated Test Plan is written by the Resident Engineers and implemented by designated staff with oversight by the SSE Division and the SSC. Open items are tracked to completion by the Resident Engineer with the assistance of the SSC; some items may be left open with a mitigation plan which takes effect after the opening of the extension or use of the modification. This must be approved by the SSC.

Safety certificates are completed for each critical system element. Certificates will be issued and signed, at a minimum, by the Resident Engineer and the SSE Division. When all required system elements are certified, a system-wide safety certificate is issued along with a safety verification report. Final authority to approve certification of extensions for revenue service rests with the Accountable Executive.

3.4.2. Procurement Process

Procurement of new systems such as facilities, equipment, buses, and light rail vehicles include safety requirements in specifications, design reviews, testing and configuration control. These procurements trigger consultation with the SSE Division to ensure basic system safety principles. Consideration is given to the following safety requirements:

- Compatible with the existing TriMet system safety features, design, and procedures.
- Incorporate "fail-safe" principles when failures would cause a catastrophe resulting in injury to personnel, damage to equipment, or inadvertent operation of critical systems.
- Avoid, eliminate, or reduce identified safety hazards by design change, safety devices, and parts or materials selection. Composition of hydraulic fluids, lubricants, and other materials shall provide optimum safety characteristics and fire-resistant properties.
- Location of equipment components so that access by personnel during operation, maintenance, repair, or adjustment activities shall not require exposure to hazards such as electrical shocks, burns, cutting edges, sharp points or dangerous or toxic materials.
- Design to minimize severe damage to equipment or injury to personnel in the event of an accident.
- Avoid undue exposure to physiological and psychological stresses, which might cause errors leading to an accident.
- Provide suitable warning and cautionary notes in instruction for operation, assembly, maintenance and repair, and distinctive markings for personnel protection on hazardous components, equipment, and facilities.

Contractors who provide systems, sub-systems, equipment that affect safe transit operations or passenger or employee safety are required to establish and maintain a system safety program in accordance with an approved SSPP. The contractor's approved SSPP must define objectives, tasks, and procedures, schedules, and data submittals for the safety activities that will be performed by the contractor. The Engineering and Construction and Facilities Division approve the contractor's system safety program plans, with concurrence of the SSE Division staff.

Additionally, all personal protective equipment to be used by TriMet personnel are reviewed and approved by the SSE Division in accordance with respiratory, hearing conservation, work at heights, lock out/tag out or other applicable safety standards. Chemicals and other potential hazardous materials being considered for purchase and use are also reviewed and approved by the SSE Division prior to arrival on site.

3.5. Continuous Improvement Program

The objective of safety at TriMet it to continually improve the processes and operations to maximize safety to the highest practicable level. This effort is undertaken by providing on-going opportunities for employees to be reminded of safety, incorporate safe practices into their operations, to hold open

discussions about safe work observations and provide multiple means for each employee to identify potential hazards to develop actions needed in their work place and on the system.

We accomplish this through safety messages, safety committee meetings, safety posters, identification and mitigation of hazards, proactive reviews and inspections to identify potential hazards. In addition to the above TriMet, personnel can make suggestions to any department or group where they may see an area of needed safety improvement. Any employee can have a request for safety assessment, which is administered by the SSE Division. Through the continuous improvement process, TriMet is then able to develop and carry out a plan to address identified safety deficiencies by:

- Prioritizing identified deficiencies and systemic hazards;
- Developing strategic initiatives to overcome known deficiencies;
- Re-evaluating progress on improvement measures through the TriMet SMS.
- Periodic review of the ASP.

3.7 Competency Management System

This document provides guidelines on aspects of TriMet's Competency Management System (CMS). It will assist in administrating assessments by providing a reference document for Managers and non-union Supervisor's (NUS) regarding specific assessment objectives, procedures, and definitions. The purpose of these guidelines is to establish assessment standards assuring rail employees an opportunity to demonstrate their knowledge and application of the rules. The (CMS) is the program to control and reduce risk. The CMS ensures employees who work in safety sensitive positions are proficient to undertake their work.

https://trinet.trimet.org/home/divisions/transportation/transportation/competency-management-system

3.8 Field Supervision

All employees are involved in assessing TriMet's ability to perform its mission through formal and informal assessments every day.

SMS Component IV – Safety Promotion

Safety Promotion section describes the responsibilities of staff to the safety program, and encouragement of others to follow established policies. It describes the training and certifications required to enhance the qualifications and competencies of agency staff. This section also describes recurring activities designed to promote and remind all employees about safety in the organization. They include means to:

- Encourage safety in the agency for employees, passengers and the public;
- Strengthen community engagement in the safety of the transit system by involving and educating community organizations and schools in transit safety; and
- Promote transit safety through training, campaigns, promotional contests, and other activities.

4 Safety Plan Implementation Tasks and Activities

The General Manager has delegated responsibility for implementing and maintaining the ASP to TriMet's COO. The COO oversees the Safety Department through the Chief Safety Officer. SMS implementation through ASP development will assure continuous improvement in the maturity of SMS. This includes TriMet's Safety Policy, and processes for Safety Risk Management, Safety Assurance, and Safety Promotion.

TriMet's implementation of its SMS is a multi-year, phased process. Based on current industry practices, the expected timeframe for a fully implemented SMS is 3-5 years. TriMet's phased approach to SMS implementation is adapted from the *Safety Management Guide, of the International Civil Aviation Organization, 2012*, and includes four (4) phases, which are detailed below. The length of time anticipated to complete each phase is included; however, these times are approximate and may vary depending on resources available, training, how efficiently the previous phase was implemented, or various other factors outside of TriMet's control.

4.1.1. Implementation Phase 1

Phase 1 sets the foundation for how TriMet's SMS requirements will be met. The framework developed during this Phase guides TriMet's implementation activities in subsequent phases. The approximate time to complete Phase 1 is anticipated to be 6 months. Activities and tasks that will occur during this phase include:

- Identification of the Accountable Executive;
- Establish the TriMet team member responsible for ensuring SMS implementation;
- Establishing the team that is responsible for SMS implementation;
- Define the system for the SMS;
- Identify the differences between TriMet existing safety efforts in comparison to SMS requirements;
- Develop a ASP defining processes for and supporting SMS implementation;
- Establish an employee safety-reporting program.

4.1.2. Implementation Phase 2

Phase 2 furthers the SMS implementation process by creating essential safety management processes while also updating existing processes to address identified deficiencies. The primary goal of this Phase is to affirm existing practices and develop those that are still needed for full SMS implementation. The approximate time for this Phase is anticipated to be 6 months. Activities that will occur during this Phase include:

- Establishment of or redefining safety policy and objectives; Also establishing impacted groups and internal and external stakeholders. This document will also affect contracts and contractors.
- Deliver training to TriMet staff regarding the ASP and SMS plan components;
- Identify impacted stakeholders and contractors affected;
- Formalize safety risk management related to SMS;
- Continuing to develop the means for safety communication as identified in Phase 1.

4.1.3. Implementation Phase 3

Phase 3 is directed toward ensuring safety information management, data gathering, and analysis processes are in place and defined. At the end of this Phase, TriMet should be able to begin to use its data to aid in safety and hazard analysis and ensure a top down; bottom up performance feedback loop is in place. The approximate time to complete this Phase is anticipated to be 6 months. Activities that will occur include:

- Formalize voluntary hazards reporting procedure;
- Refine the safety risk management procedure;
- Refine occurrence reporting and investigation processes;
- Establish safety data collection system and metrics for which this data will be analyzed;
- Establish a formal management of change procedure that focuses on safety risk management;
- Review and update TriMet's internal and external audit or review program;
- Continue SMS training for TriMet personnel.

4.1.4. Implementation Phase 4

Phase 4 will finalize the SMS implementation process. This Phase focuses on Safety Assurance and relies on periodic monitoring and feedback to identify and correct issues in the SMS. The approximate time to complete this phase is anticipated to be 6months. This will assure a continuous feedback loop. Activities that will occur include:

- Further refine the voluntary reporting procedure to include integration of hazards identified from these occurrence reports;
- Integrate hazard identification and safety risk management procedures with TriMet contractors;
- Integrate hazard identification and safety risk management procedures for dealing with items identified by the public (non-employees);
- Further define safety performance indicators to include targets;
- Establish operational and safety culture surveys for TriMet employees in order to gauge effectiveness of the SMS;
- Continue SMS training for TriMet personnel;
- Review and refine means of safety communication (if needed).

4.1.5. Safety Task Responsibility Matrix

The Safety Task Responsibility Matrix, which identifies the TriMet Departments and specific tasks necessary to implement TriMet's SMS, is provided above in **Section 1.4.3: Safety Accountabilities and Responsibilities Matrix.**

4.2. Safety Training Program

All TriMet personnel directly connected with the operation of buses or trains will be required to undergo certification and re-certification training, as necessary.

Each TriMet Department's role in this function is to:

- Maintain each of their employees' training, certification, and recertification records.
- Train department employees in elements of the ASP and safety programs that have relevance to their positions.
- Document the training in accordance with their department's practices. This may be through an electronic learning management database, or through hard copy files.
- Develop programs to ensure training adequately communicates the specific hazards employees may be exposed to; implement appropriate hazard control methods; provide warnings and restrictions; develop safety rules and procedures; and practice emergency procedures including those related to response, communication, and evacuation. Employees must receive required training and/or certification/recertification as it pertains to their discipline.
- Distribute and display safety information such as bulletins, notices, rule changes, and posters in a manner that effectively communicates the information to employees.
- Educate contractors and sub-contractors of their role in achieving objectives and targets.
- Monitor and document compliance with the training through periodic inspections.

Employees, whose duties directly affect the safe operation of the system, will be formally trained and certified by successfully passing specialized training courses. In addition, these employees must pass recertification on a regularly scheduled basis to retain their positions.

All members of employee safety committees are required to attend OSHA trainings as a part of their duties on the safety committee specifically these online trainings are:

1. Hazard identification training
2. Accident Investigation training (to learn the principles of accident and incident investigations for use in evaluating those events), and
3. Safety committees and Meetings.

4.2.1. Compliance with Local, State and Federal Requirements

Development and preparation of the ASP is in accordance with the documents below. Modification to these documents may result in updates to the ASP as necessary to maintain conformance.

- Federal Transit Administration (FTA) regulation: Rail Fixed Guideway Systems; State Safety Oversight, 49 CFR, Part 673.

- FRA regulations as they pertain to the limited connection and seven highway-grade crossing for those segments in the Portland-Milwaukie segment of the Light Rail Transit (LRT) (see System Description).
    - 49 CFR Part 214 - Roadway Worker Safety Program,
    - 49 CFR Part 217 - Operational Testing Program,
    - 49 CFR Part 220 - Radio Communications,
    - 49 CFR Part 222 - Quiet Zones
    - 49 CFR Part 225 - Accident/Incident Reporting and Internal Control Plan,
    - 49 CFR Part 228 - Hours of Service – (Controllers and Signal Technicians only),
    - 49 CFR Part 233 - Signal Systems Reporting (applicable only to the OPRR crossing)
    - 49 CFR Part 234 - Systems for Telephonic Notification of Unsafe Conditions at Grade Crossings
    - 49 CFR Part 236 - Railroad Signals Maintenance Standards (applicable only to the OPRR crossing)
    - 49 CFR Part 243 – Railway Safety Training
    - 49 CFR Part 655 – Drug and Alcohol
    - ODOT regulation: ODOT State Safety Oversight Program Standards Oregon Administrative Rules (OAR) 741-060-0010 through 0110.

4.2.2. SSE Division Safety Training Requirements

Designated TriMet employees must obtain training per requirements in CFR 672.13 a, b and c; personnel designated in providing safety oversight shall complete applicable training requirements within three (3) years of their initial designation and refresher training every two (2) years for designated personnel. Individual training plan components for Chief Safety Officer and the staff whose primary job function includes safety oversight are required to complete training in the following FTA courses to receive a Transit System Safety Program (TSSP) Certification:

1. Effectively Managing Transit Emergencies;
2. Transit Rail System Safety;
3. Transit Rail Incident Investigation;
4. SMS Awareness;
5. SMS Safety Assurance;
6. SMS Principles for Transit.

4.3. TriMet Compliance Training and Certification Program

The SSE Division provides access to safety training for employees. Employees exposed to chemicals or to physical agents receive training in hazard communication, use and care of personal protective equipment, and hazards and safe handling methods of chemicals. Blood borne pathogens training is provided for employees who are required to cleanup bodily fluids.

In addition, pertinent information is distributed through bulletins, newsletters, and postings to employees about current topics. SSE Division coordinates with transportation and maintenance training instructors in formulating and refining training programs.

4.3.1. Operationally Related Safety Training

Safety training is conducted about TriMet equipment and operating rules and procedures. Copies of SOPs and rules are given to all TriMet operating personnel. SOPs and rules are formulated by the Operations Division and submitted to TCRC for review and approval. Training programs are developed and coordinated by V Division to ensure that the safety message remains forefront and include sound safety practices.

All Rail Operations and Maintenance personnel must pass an annual examination of the safety rules and procedures. Each person who fails the annual examination is given special retraining. The preparation, administration, and maintenance of these examinations and related records are the responsibility of the employee's respective department.

4.3.2. LRV Operator Training

All new train operators participate in the LRV operator-training course. This course covers rules, procedures, and actual train operation. Each new LRV operator is certified with both written and practical testing to validate operational readiness and knowledge of operating and safety rules and procedures. Annually, each operator is given a refresher course on the rules and procedures, and will re-certify with written and practical testing. In addition, training is given when a new extension is opened or when a significant change is made to the functionality of the operating system. All training records are maintained by the Rail Transportation Training Department.

Rail Specific Safety Training is generally required for all persons working on the TriMet Rail System. In certain cases, persons may conduct work on the TriMet rail system without attending safety training, provided they are escorted by an individual who is currently certified in Roadway Worker Protection (RWP) training, consistent with FRA CFR 214. The purpose of safety training is:

- To identify the rail system operating practices and standards;
- To ensure safe operation of the rail system;
- To ensure the safety of all persons working on or about the rail systems as well as the riding public;
- Rail Transportation Instruction provides the training and refresher training required to employees, contractors, subcontractors, law enforcement and fire services personnel.

4.3.3. LRV Field Supervisor and Controller Training

LRV Field Supervisors receive training in LRV operations, rules, standard and emergency operating procedures, incident command and emergency response, accident/incident investigations, customer assistance, and Light Rail Vehicle troubleshooting. Supervisors are certified through both written and practical testing to validate operational readiness and knowledge of the rules and procedures.

Rail Controllers receive training in the areas of train movements; tunnel emergency systems procedures, emergency response management, and coordination of maintenance and construction activity within the LRV right-of-way. Controllers are certified through both written and practical testing to validate knowledge and expertise in responding to a wide range of operating situations and problems.

Bus Dispatchers receive training in emergency procedures and emergency response management. They are certified through both written and practical testing to validate knowledge and expertise in responding to a wide range of operating situations and problems.

Rail Field Supervisors and Controllers receive refresher instruction and are re-certified annually through written and field examination. In addition, Rail Field Supervisors are required to do a monthly certification

trip. Controllers and Supervisors attend the annual recertification for Rail Operators. The Field Supervisors retain their Operator certification. All training records are maintained by Field Operations or by Training.

4.3.4. Rail Equipment Maintenance Personnel Training

Rail equipment maintenance requirements, methods and procedures of rail equipment and systems, are described in manuals, handbooks, and other documentation developed for the training and certification of maintenance personnel. Use of personal protective equipment (PPE), emergency equipment, and safety instruction are included in the training program. All personnel who work on Light Rail Vehicles (LRVs) are certified journeymen and must complete a state sponsored program. Paperwork is maintained by the State and by the maintenance trainers. Apprentices work under the direct supervision of journeymen mechanics.

Rail equipment maintenance personnel who operate LRVs, high-rail equipment, heavy equipment, or other specialized vehicles and equipment are certified by both written and practical testing to document the employee's knowledge of safety and operating procedures and skill in proper and safe operation and procedures. Each employee will re-certify in the proper and safe use of the following equipment/vehicles with written and practical testing:

- Forklift – recertification training conducted every 3 years
- High-rail and rerail – recertification training conducted annually
- REM LRV operation – recertification training conducted every 3 years
- Rail maintenance personnel who work on energized electrical equipment are trained and certified in lockout/tagout, first aid and CPR/AED. Each applicable employee will re-certify in the following safety training with written and practical testing.
- CPR/AED - recertification training conducted annually
- First Aid - recertification training conducted every 3 years
- Lockout/Tagout – recertification training conducted annually
- RWP Training – refresher required every two years.

Required recertification is completed every 3 years or annually, as required, but no later than 30 days from the employee's anniversary training date. The maintenance trainers retain all the paperwork.

4.3.5. Bus Maintenance Rules and Procedures

There are formal training programs for employees involved in maintenance activities. These include training classes, training manuals, and lesson plans. Testing is conducted as necessary to ensure training effectiveness, and all safety training is documented. TriMet utilizes safety-training programs as a means of informing employees about hazards associated with their jobs and the appropriate methods for controlling these hazards. The safety training efforts of TriMet fall into three main types of training: 1) Initial, 2) Periodic and 3) Retraining. Training mechanisms include classroom, written and video communications, computer-based training, field exercises, and drills.

4.3.6. Bus Operator Training

TriMet is responsible for training new Bus Operators in defensive driving, rules pertaining to safe vehicle operation, pre-trip and pre-pullout inspections, emergency procedures, and injury and illness prevention. This group also performs re-training following traffic accidents, occupational injuries, and as otherwise

warranted. Operators are required to receive 8 hours of training per year under the Transit Training Program. This training is conducted by training staff and records

4.3.7. Maintenance of Way Training

Maintenance of Way (MOW) requirements, methods and procedures are described in manuals, handbooks, and other documentation developed for the training and certification of MOW personnel. Use of PPE, emergency equipment, RWP, LOTO and safety instruction are included in the training program.

MOW includes the following disciplines: substation technicians, overhead technicians, track maintenance, and signals technicians. Each discipline has a training program consisting of both written and practical testing to document the employee's knowledge of safety and operating procedures and skill in the proper and safe operation and procedures.

MOW Training maintains these training records.

4.3.8. Compliance Assessments for Training

A variety of methods is used to assess compliance with training and certification requirements including:

- Rail Operators are assessed by "Observation Rides". These are conducted by Rail Operations Training Assistants. Prior to the ride, the Training Assistant review the Operators files and looks for documented issues or complaints. Once the ride is completed, any observations or concerns are discussed with the Operator. Follow- up rides may be conducted if needed. The Training Assistants' observations are documented. These are kept electronically by the training department.
- Supervisor's reports are reviewed to assure compliance with training and certification requirements; conversations with the OCC are recorded and may be reviewed.
- SSE provides oversight to ensure that contractors comply with applicable laws and requirements. Oversight may include a review of work plans, site visits and audits.
- Bus Operators are assessed by "Observation Rides" conducted by Training Supervisors. Once the ride is completed, any observations or concerns are discussed with the Operator. All of the Training Supervisors observations are documented. These are kept electronically by the Training department.
- Maintenance of Way employees are assessed by their Supervisors. These "spot checks" are conducted as frequently as deemed necessary. In addition, all reports are entered into an electronic tracking system and are reviewed by management.
- Rail Equipment Maintenance uses Maintenance Supervisor staff for monitoring compliance with established procedures, rules and regulations whether they are TriMet generated, regulation, or industry standards, such as APTA. This is done by reviewing work tickets & related documents (check sheets), direct visual supervision of work practices in the shop and communication relating to individual work performance with training staff, fellow Supervisors, and the Maintenance Manager.

4.4. Construction Safety

Construction safety is administered in accordance with TriMet's Construction Safety Program, contract specifications, and applicable federal, such as Occupational Safety and Health Administration (OSHA), state and local safety requirements. Program details are included in the manual entitled, TriMet's Construction Safety Program. The document outlines the minimum requirements for contractors performing work within the TriMet transit system.

The Engineering and Construction Division approves the contractor's safety plan and supporting documentation, under the advice of the SSE Division. Audits of the contractors are conducted to assure compliance with federal and state laws, and TriMet's requirements. TriMet staff review and approve all contractor safety plans for minor projects. This includes pre-work Job Hazard Analysis (JHAs) for approval prior to initiation of any work on TriMet properties. Contractors are required to complete incident and accident investigation reports and well as corrective action plans to mitigate risks.

All personnel that work in proximity to the rail alignment are also required to attend Track Access Training. This training is provided by the SSE Division and Capital Projects.

4.5. Employee Contractor Safety Programs

An important aspect of safety compliance falls under Occupational, Safety and Health rules, regulations, guidance, and initiatives. TriMet safety staff work closely with managers, supervisors, and contractors and employees to ensure understanding of the various requirements of Occupational, Safety and Health rules, as well as other federal, state, and local rules, standards, and ordinances.

Contractors performing work at TriMet, who bring chemicals onto property, are required to participate in a contractor environmental briefing. Copies of Safety Data Sheets of chemicals are provided to TriMet by the contractors. Contractors must present their work plan and employee personal protection procedures for handling chemicals associated with the contracted work. Contractor personnel who demonstrate a lack of understanding of applicable rules and procedures may be removed from the work site and require additional safety training be conducted.

Appropriate personal protective equipment (PPE) such as safety glasses, safety boots, gloves, face-shields and work uniforms is provided and use is required in performing various work by TriMet personnel. This equipment is evaluated and approved by SSE Division prior to procurement. Employees who are required to wear approved safety work boots may use a tool or uniform allowance.

Contractor personnel who work in the right-of way during rail traffic are required to attend a TriMet sponsored course in Roadway Worker Protection that covers right-of-way flagging and operating procedures. Only qualified personnel are permitted in the right-of-way. Contractors who may work in TriMet environments with unique or unusual occupational hazards are provided familiarization training to ensure they are aware of hazardous conditions and how to protect themselves.

4.6. Safety Communication and Outreach

TriMet believes in the importance of effective communication to build a more robust safety culture. Training is one example of communication. The methods described below are ways in which TriMet communicates safety and safety performance information with employees. In addition to regular safety messages and information on hazards and safety risks and safety actions relevant to employees' roles and responsibilities and the submittals to the employee safety reporting system, TriMet will continually

communicate safety performance information throughout the organization. TriMet will convey information on hazards and safety risks as well as safety actions taken in response to employee concerns at TCRC.

The Marketing and Customer Service Department (Community Relations) provides information regarding TriMet programs, operations, and events. With regard to safety, the department develops and conducts various communications to committees and the community concerning safety awareness programs and key safety information. Some of these are public facing initiatives and provided to local schools, communities, citizen groups, media, and patrons. These programs and packages highlight the risks to safety and the need for safe behavior on or around TriMet equipment and facilities.

In addition, On-Street Customer Service staff (Field Reps, Ride Guides and volunteers) provides one-on-one safety education to customers using TriMet's buses and trains. During special events and service disruptions, On-Street Customer Service staff actively encourages customers to behave safely around buses and trains. During winter storms, On-Street Customer Service staff provides winter safety tips to customers, and report potential safety issues (e.g. icy platforms) through OCC. Internal messaging concerning safety tips is broadcast in break rooms at TriMet facilities. These messages can contain information about any number of safety themed items. The Marketing Department may conduct outreach or participate as inspection team members at the request of the SSE Division.

4.6.1. Environmental Management Program

It is the environmental services department has responsibility to ensure that TriMet maintains compliance with all applicable Federal, State, and local environmental obligations. Environmental services manages environmental permits and records, conducts routine inspections of maintenance facilities, performs maintenance and upkeep of our environmental infrastructure, and provides employee training so everyone at TriMet understands their role in meeting compliance obligations and preventing pollution.

4.6.2. Industrial Hygiene Program

TriMet conducts regular industrial hygiene surveys, such as air quality, noise levels, hazardous materials, including wastes and environmental issues, to evaluate the degree of employee, customer, or environmental exposure or impact to chemical and physical agents encountered in the work environment, including the offices. The basis for surveys is through the evaluation of work processes and reports of injury and occupational disease. Survey results are used to determine engineering and administrative controls and the need for personal protective equipment. Reports of the industrial hygiene surveys are submitted to all affected department directors, managers and employees.

Reference: Hazard Analysis Approaches

When conducting any of the following analyses, two approaches are used:

- Inductive Analysis – A method that determines the effect on a specific event or component failure on a system. This is a bottom-up approach, meaning that it asks, "What happens if a specific event or component failure occurs?" This proactive approach begins by identifying potential hazards with components and then works to discover potential undesirable events.
- Deductive Analysis – An analysis of a specific undesired event to determine the possible causes of that event. This is a top-down approach, meaning that it asks, "What caused or can cause a specific event to occur?" This reactive approach begins by identifying a specific incident and then works to discover the potential causes.

Preliminary Hazard Analysis (PHA)

The PHA serves as the initial hazard identification effort. If forms the basis for system safety analysis. This analysis is used as the source for initial design requirements, data for concept and trade-off studies, and as evidence of specific safety consideration. See the reference section for an example. The steps involved in performing this analysis are:

- Identify the system
- Establish design requirement
- Define operating procedures
- Identify hazards
- Recommend corrective action(s)
- Reduce hazards to an acceptable level

The following information can be helpful when developing a PHA:

- Preliminary system description
- Generic hazard lists
- Previous experience
- Codes, standards, and recommended best practices
- Mathematical models, scale models, mock-ups
- Fault tree analyses

Products derived from the PHA are any or all of the following:

- Initial identification of hazards
- Guide to future system safety/security analysis/assessment efforts
- Recommend controls
- Documentation

Subsystem Hazard Analysis (SSHA)

The Subsystem Hazard Analysis is an inductive analysis used to determine the effect of specific events or component failures on a system. It is used to determine potential hazardous incompatibility between assemblies or subsystems. The steps involved in conducting this analysis are:

- Identify and define the subsystems
- Analyze subsystem components to determine hazardous failure modes
- Recommend corrective action(s)
- Reduce hazard(s) to an acceptable level

The following information can be helpful when developing a SSHA:

- Previous experience
- Manufacturer's drawings
- Reliability data
- Codes, standards, and recommended best practices
- Results of PHA
- Results of SA

Products derived from the SSHA are any or all of the following:

- Identification of hazards – single point failures
- Identification of component reliability deficiencies
- Inputs for System Hazard Analysis (SHA)
- Inputs for Software Safety Analysis (SSA)
- Inputs to Security Analysis (SA)
- Inputs to Threat and Vulnerability Assessment (TVA)
- Recommended controls
- Documentation

Operating and Support Hazard Analysis (O&SHA)

The Operating and Support Hazard Analysis is used to identify and analyze hazards associated with personnel and procedures during production, installation, testing, training, operations, maintenance, and emergencies. This analysis will provide corrective or preventative measures to be taken to minimize the possibility that any human error or procedure will result in injury or system damage. See the reference section for an example. The purpose of the O&SHA is to identify the following:

- Hazardous activities in operations
- Design changes
- Safety devices
- Warnings, cautions, and special procedures
- Special procedures for handling hazardous materials
- Training requirements
- Security issues

The following items should be analyzed:

- Tasks

- Human/Machine Interface
- Operation sequences
- Instructions
- Warnings/Cautions
- Mental/Physical demands
- Time requirements

The following information can be helpful when developing an O&SHA:

- Previous experience
- Operations manual
- Maintenance manual
- Previous analysis
- PHA
- SSHA
- SHA
- SSA
- SA

Products derived from the O&SHA are any or all of the following:

- Identification of operational safety hazards
- Recommended design improvements
- Recommended corrective/preventative measures to reduce or eliminate human error
- Recommended safety devices, warning devices, procedures, or training to protect employees and patrons
- Documentation

Failure Modes, Effects, and Criticality Analysis (FMECA)

The Failure Modes, Effects, and Criticality is a reliability evaluation/design technique that examines potential failure modes within a system and its equipment in order to determine the effect on equipment and system performance. Products derived from the FMECA are any or all of the following:

- Determining the effect of each failure mode on performance
- Root cause identification and development of corrective actions
- Investigation of design alternatives
- Development of test methods and troubleshooting techniques
- Identification of single point failure modes
- Qualitative safety and support analyses
- Providing data for developing Fault Tree Analysis
- Estimating system critical failure rates
- Identifying safety critical components as well as their reliability

Fault Tree Analysis (FTA)

The Fault Tree Analysis logically and graphically displays the paths to failure for a system or component. The eight (8) steps in this process are:

- Define the system
- Define top-level faults
- Identify causes for top-level faults
- Identify next level of events
- Identify root causes
- Add probabilities to events
- Analyze the fault tree
- Document the fault tree analysis

Software Safety Analysis (SSA)

Software control is a growing technology for automated equipment in the transit industry. The Software Safety Analysis is used to identify, analyze, evaluate, and specify control of software hazards. The following information can be helpful when developing an SSA:

- MIL-STD-882E Software test analysis methods
- Other analyses to extract software problems
  - PHA
  - SSHA
  - SHA

Products derived from the SSA are any or all of the following:

- Define software hazards that will prevent hardware from operating properly
- Identify security issues that will have operational impact on the system
- Illustrate the importance level of automated equipment failures
- Develop items for emergency procedures to control emergencies
- Develop procedures for manual operation of equipment

Security Analysis (SA) and Threat and Vulnerability Assessment (TVA)

The Security Analysis is systematic process that evaluates the effectiveness of an organization's system security program, plan, policies, and procedures. It is used to identify strengths and weaknesses as well as to propose resolutions to management. This analysis can be accomplished either internally or externally. The Threat and Vulnerability Assessment is a systematic process used to identify, access, and resolve security threats to the system. The following information can be helpful when developing a TVA:

- Preliminary system description
- Generic hazards list
- Previous hazards, security risks
- Codes, standards, and recommended best practices
- Mathematical models, scale models, mock ups
- Fault Tree Analyses

The following are issues that can be identified using a TVA:

- Physical areas that are susceptible to criminal activity
- System policies that may encourage criminal activity
- Critical assets of the system

- Security design criteria for new projects and procurement of new equipment and/or systems
- Steps that may be taken to improve system management to handle security issues
- Justification and supporting documentation to qualify for DHS/TSA Transit Security Grant Program

Products derived from the TVA are any or all of the following:

- Initial identification of threats and vulnerabilities
- Guide for future system security assessments
- Recommended security controls
- Recommendations for the SSP
- Documentation

Job Hazard Analysis

The Job Hazard Analysis (JHA) is a tool to assist with risk assessment and hazard recognition, evaluation, and control. A JHA is a documented, systematic process that identifies and assesses existing and potential health and safety hazards associated with a particular task or job. It focuses on the relationship between the worker, the task, the tools, and the work environment. Ideally, after you identify uncontrolled hazards, you will take steps to eliminate or reduce them to an acceptable risk level. See the reference section for an example.

A job hazard analysis can be conducted on many jobs in the workplace. Priority should go to the following types of jobs:

- Jobs with the highest injury or illness rates
- Jobs with the potential to cause severe or disabling injuries or illness, even if there is no history of previous accidents
- Jobs in which one simple human error could lead to a severe accident or injury
- Jobs that are new or have undergone changes in processes and procedures
- Jobs complex enough to require written instructions

The following steps will assist you when developing a JHA:

- Involve employees
- Review accident history
- Conduct preliminary job review
- List, rank, and set priorities for hazardous jobs
- Outline the steps for task

Reference: TriMet Example Hazard Log and Descriptions

TRIMET

Bus Route Hazard Log

				Initial Findings					Recommendations			Resolutions						
				Hazard Identification			Initial Hazard Rating (Pre-Resolution)			Recommended Hazard Rating (Post-Resolution)			Final Hazard Rating (Post-Resolution)		Resolution Status			
Hazard ID No.	Location Reference	Hazard Type	Life Cycle Phase	Potential Hazard	Potential Cause(s)	Effects	Hazard Category	Hazard Risk Index	Potential Mitigation (s)	Hazard Category	Hazard Risk Index2	Final Mitigation (s)	Hazard Category2	Hazard Risk Index4	Assessment Checklist Reference	(Open/Closed)	Date Closed	Closure Reference & Notes
BR-1	4 Division/Fressenden	Compromised Line of Sight - Vegetation	Maintenance Operations	Line of sight is compromised due to obstructions along the bus route.	(1) Vegetation encroaching bus lane due to lack of maintenance.	(1) Vehicle collision with tree branches causing significant property damage. (2) Potential for severe personal injury. (3) Significant increase in operator workload causing reduction in safety margins. (4) System interruptions or significant vehicle downtime.	IV-D	3	(1) Coordinate with PBOT to maintain and cut back vegetation. (2) Alert bus operators to the hazard and train how to appropriately avoid.	IV-E	4				BR-4-1.4 BR-4-1.5	Open		
BR-2	4 Division/Fressenden	Collision - Fixed Structures and Objects	Maintenance Operations	Line of sight is compromised due to obstructions along the bus route.	(1) Buildings blocking line of sight at several intersections.	(1) Vehicle collision with pedestrian or another vehicle. (2) Potential for personal injury. (3) Significant increase in operator workload causing reduction in safety margins. (4) System interruptions or significant vehicle downtime.	IV-D	3	(1) Alert bus operators to the hazard and train how to appropriately avoid. (2) Coordinate with police to increase enforcement of illegally parked vehicles.	IV-E	4				BR-4-1.4 BR-4-1.5	Open		
BR-3	4 Division/Fressenden	Compromised Line of Sight - Vehicles and Equipment	Maintenance Operations	Line of sight is compromised due to obstructions along the bus route.	(1) Carrier trucks parked illegally along route are blocking line of sight.	(1) Vehicle collision with pedestrian or another vehicle. (2) Potential for personal injury. (3) Significant increase in operator workload causing reduction in safety margins. (4) System interruptions or significant vehicle downtime.	IV-D	3	(1) Alert bus operators to the hazard and train how to appropriately avoid. (2) Coordinate with police to increase enforcement of illegally parked vehicles.	IV-E	4				BR-4-1.4 BR-4-1.5	Open		
BR-4	4 Division/Fressenden	Collision - Bicycles and Pedestrians	Maintenance Operations	Collision hazard due to bus traveling into bicycle lanes.	(1) There aren't designated bicycle lanes in some locations causing cyclists to travel in bus lanes.	(1) Vehicle collision resulting in severe personal injury or death. (2) System interruptions. (3) Significant property damage. (4) Cyclist or pedestrian struck by bus or another vehicle causing death or severe personal injury.	II-D	2	(1) Coordinate with PBOT to mark bike lanes where possible. (2) Alert bus operators to the hazard and train how to appropriately avoid.	II-E	3				BR-4-1.8 BR-4-1.9	Open		

Hazard ID No.	Location Reference	Hazard Type	Life Cycle Phase
(1)	(2)	(3)	(4)

Item (1): Enter a unique **Hazard ID Number** to identify the hazard.

- Examples: BR-021, BS-012, TC-070

Item (2): Enter a clear description of each **Location Reference** where this hazard is known to exist.

- Examples: Bus Stop 5069, Transit Center 8, Bus Route 12

Item (3): Enter a clear description of the **Hazard Type**.

- Examples: Emergency Response, Collision, Tripping/Walking Surface

Item (4): Enter the **Life Cycle Phase** for this hazard.

- Examples: Design, Installation, Maintenance, Operations

Initial Findings				
Hazard Identification			Hazard Rating (Pre-Resolution)	
Potential Hazard	Potential Cause(s)	Effects	Hazard Category	Hazard Risk Index
(5)	(6)	(7)	(8)	(9)

Item (5): Clearly describe the **Potential Hazard**. Remember, a hazard is the functional failure or the non-existence of a particular function.

- Examples: Electrocution, Derailment, or Fire. Be sure to assign each hazard a new Hazard ID.

Item (6) Cleary describe the **Potential Causes**. (What would cause the functional failure or is a function missing?)

- Examples: Lack of proper maintenance, No signage present to direct passengers

Item (7) List any potential **Effects** of the hazard. (If this hazard creates an incident, how will that affect the system?)

- Examples: Service Disruption, Injury, or Damage to infrastructure.

Item (8) Enter the **Pre-Resolution Hazard Category**. (Hazard Severity and Probability)

- Example: 1A-E to 5A-E

Reference

Item (9) Enter the **Hazard Risk Index** derived from the entry in Item 8.

- Example: 1,2,3,4,5

Recommendations		
Recommended Resolution(s) / Mitigation(s)	**Recommended Hazard Rating (Post-Resolution)**	
	Hazard Category	**Hazard Risk Index 2**
(10)	**(11)**	**(12)**

Item 10: Enter **Recommended Resolution(s) or Mitigation(s)**. Be sure to include subject-matter-experts.

- Examples: Provide regular maintenance or install signage.

Item 11: Enter the **Post-Resolution Hazard Category.** (Hazard Severity and Probability)

- Example: 1A-E to 5A-E

Item 12: Enter the **Hazard Risk Index** derived from the entry in Item 11.

- Example: 1,2,3,4,5

Resolutions						
	Final Hazard Rating (Post-Resolution)			**Resolution Status**		
Final Resolution(s)/ Mitigation(s)	**Hazard Category**	**Hazard Risk**	**Assessment Checklist Reference**	**(Open/Closed)**	**Date Closed**	**Closure Reference & Notes**
(13)	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**

Item 13: Enter **Final Resolution(s) or Mitigation(s)**. Be sure to include subject-matter-experts.

- Examples: Provide regular maintenance and install signage.

Item 14: Enter the **Final Hazard Category.** (Hazard Severity and Probability)

- Example: 1A-E to 5A-E

Item 15: Enter the **Final Hazard Risk Index** derived from the entry in Item 14.

- Example: 1,2,3,4,5

Item 16: Enter the **Assessment Checklist Reference** information.

Item 17: Indicate the **Resolution Status.** (Open or Closed)

Item 18: Enter the **Date Closed.**

Item 19: List **Closing Reference(s) & Notes**

Reference

- Examples: As-Built Drawing Number and Visual Verification Document.

Reference: TriMet Committee Description

1. Transportation and Maintenance Safety Committees

The purpose of TriMet's Bus and Rail Maintenance and Transportations Safety Committees is to bring management, employees and employee representative together to achieve and maintain a safe, healthful workplace.

Goals

- Evaluate employee concerns about safety and security hazards
- Assist in identifying and reporting hazards in the workplace
- Review injury reports and provide recommendations to reduce recurrence
- Assist with workplace inspections

Objectives

- Address concerns and recommend mitigation
- Provide management with information concerning hazards and provide recommendations for mitigation
- Reduce recurrence of injuries to employees

Membership: Safety Committees include management, employees, a SSE representative and employee representatives. The Committee will be made up of applicants, but management may appoint persons if no applicants are available. If multiple persons apply for membership, the existing committee will elect members. Committee membership is an option for any staff member. Committee members are expected to serve a minimum of one year.

Officers and Representatives: Each committee will have a Chairperson, elected by the committee members. The Chairperson will be responsible for conducting meetings, establishing an agenda and selecting the time and place of the meeting. The Chairperson will send out meeting notices on a monthly basis

Each committee will have a Recording Secretary. The Recording Secretary is responsible for producing and retaining all documentation. This includes documenting meetings and producing meeting minutes, maintaining files, and posting minutes. All documentation will be retained electronically for a minimum of three years. In addition, the Recording Secretary will document any hazards found in the Safety Inspections and track any recommendations to resolution.

Each committee will include a member of the SSE. This person will be responsible for bringing injury documentation to the monthly meetings and leading safety inspections.
Other members of the committee are responsible for reporting employee concerns and hazards, providing recommendations to mitigate hazards, and participating in facility inspections.

Training: All members of the Safety Committee will be trained in hazard identification.

Meetings: Meetings will be held at least quarterly and may include program reviews, injury reviews, and reviews of employee concerns. All decisions involving change will be voted on by the committee members. The Committee may elect to bring issues to the attention of the TCRC.

Facility inspections may be conducted instead of a regular committee meeting. All members of the Safety Committee can be part of the inspection team.

Employee Involvement: Employees may, verbally or in writing, share a safety/security concern with a Safety Committee member who will bring the concern to the attention of the committee. Any Safety Committee member can bring employee concerns to the Safety Committee. If the Committee members believes that an employee concern has identified a hazard that might result in immediate injury to any employee, he/she may contact their Supervisor or a member of the Safety/Security Department.

Accident/Injury Investigation: Safety Committee members will review injuries and reported "close calls". Any recommendations will be sent to the effected manager by the Chairperson. All recommendations will be tracked by the Recording Secretary.

Workplace Inspections: Inspections will be conducted on a quarterly basis. All Committee members will participate in these inspections. The member of the SSE Division serving on the committee will direct and assist committee members.

2. Safety and Security Committee

The purpose of the Safety and Security Committee is to assist in the detection and elimination of unsafe conditions and work practices that may lead to accidents and injuries to the public and TriMet employees.

A Committee is created for each new rail extension. Members of the committee include the Project Manager, Operations Support, Rail Transportation, a Safety Representative and Maintenance of Way. ODOT and PDOT are invited to attend on as as-needed basis. The committee reviews the design, works with the Project Manager to identify and eliminate hazards, and must approve the design.

3. Transit Change Review Committee

TCRC was established to review and approve all proposed changes and modifications existing bus and rail systems safety baselines. Any additions, modifications, or deletions to Bus or Rail Operations SOP, and to the existing safety configuration of operating bus or rail system fixed facilities, rolling stock, and equipment directly related to operation of rolling stock, are reviewed and approved by TCRC. These reviews are established to ensure that system and operational changes are approved prior to implementation, and those drawings, manuals, and other related documents, including training programs, are updated to reflect these changes. Specifically, committee members are responsible for the development and review of proposed changes to:

- Operating Rules;
- SOPs;
- Configuration of bus or rail equipment, bus or rail systems, and facilities, including those affecting the safety of TriMet operations;
- Bus and Light rail vehicles.

TCRC may also recommend changes to bus and light rail training programs, as identified through incident reviews, audits, and other assessments. Members include the SSE Executive Director (Chair) or their designee (co-chair); the Director of Facilities Management; Director(s) Bus and Rail Transportation, Director Maintenance of Way, Director(s) Bus and Rail Equipment Maintenance; the Field Operations Manager; the System Engineering Manager and the SSE. All members participate in the evaluation of

changes and must reach consensus. Technical experts may attend committee meetings to clarify proposed changes. ODOT, as the designated safety oversight agency, is an ex officio member of TCRC.

Additionally, the TCRC evaluates the effectiveness of the Bus and Rail system safety programs and activities and its implementation through the review of safety audits, major incident or accident investigations, and safety related statistics to reduce the potential for recurrence of similar incidents and negative trends. Major safety or security incidents include any incident that has potential for significant liability of TriMet, results in significant, sustained, or unusual disruption of transit service, results in death or serious injuries to persons on TriMet premises or vehicles and/or has potential for high public/media interest or controversy.

4. Fire/Life Safety/Security Committee

The purpose of the committee is to identify and work through issues related to the new rail extensions; a committee is formed for each new start. The committee develops lists of potential issues related to the project and identifies mitigations and solutions to those problems/issues.

The committee is comprised of stakeholders affected by the project, as well as assisted by members of the TriMet Engineering and Construction team assigned to various segments of the alignment. These stakeholders may include representatives from the City of Portland, Sheriff's Office, Fire & Rescue, TriMet Transit Police, TriMet Operations Support, TriMet Field Operations, TriMet Maintenance of Way, TriMet Rail Equipment Maintenance, TriMet Facilities Maintenance, TriMet Community Relations, TriMet Bus Transportation, and/or TriMet Rail Transportation

5. Bus and Rail Accident Review Committees

These committees are composed of two Operators, two Trainers, one Union Representative and a representative from Safety. The Bus Review Committee meets twice per month and reviews all bus accidents, with respect to preventability. Any hazards noted, such as stop placement or overgrown vegetation is referred to the party responsible for assessment and mitigation. This could include referral to the TCRC, one of the Safety Committees, or a specific department. Any issues with the actions of the Operator are referred to the training department.

The Rail Review Committee meets once per month and reviews all rail accidents with respect to preventability. Any hazards noted, such as stop placement or overgrown vegetation is referred to the party responsible for assessment and mitigation. This could include referral to the TCRC, one of the Safety Committees, or a specific department. Any issues with the actions of the Operator are referred to the training department.

6. Continuous Improvement Teams

Continuous Improvement Teams (CIT) are temporary teams of managers, supervisors, and frontline employees assembled to address specific safety and security issues. The teams are temporary, typically lasting several months until the team's actions are fully implemented. CITs have addressed roadway worker protection, bus ergonomics, operator assaults, and rail rulebook modifications.

Reference: Internal Audit Description

The SSE Division ensures that all audits are performed on a coordinated basis with the support of TriMet management. Once the scope and audit date are established, the involved department or unit are required to provide full cooperation to the auditors. Any portion of the audit may be repeated during the cycle.

Both announced and unannounced inspections may be performed. Audits are scheduled to minimize disruption of activities. Unannounced audits may be performed where only the SSE Division and the audit team are informed.

Auditing teams utilize checklists approved by the SSE Division and/or Manager of the group being audited. The audited group is given the opportunity to provide support documentation to the auditors to "close" the items on the checklist. Confidential documentation, unless approved by the General Manager, is not part of the audit.

All audits are fully documented. A draft report is submitted to the responsible group for review and comment. If there is no disagreement with the audit findings and recommendations, the auditing team will then submit a final report, along with the checklist, to the SSE Division. The SSE Division will submit a final audit report to the manager, director, and executive director of the department audited; the Chief Operating Officer; and, to SSOA/ODOT. TCRC can also be informed of the higher risk audit findings during the monthly meetings. Audit reports include:

- Elements and activities of the ASP audited;
- Name(s) of the auditor(s);
- Audit date(s);
- Checklists and procedures used;
- Summary of findings, including open items and problem areas; and
- Required corrective actions, if any.

A formal Corrective Action Plan (CAP) is developed for catastrophic (level 1) and critical (level 2) by the department/unit audited, with concurrence from the SSE Division; this is made available to SSOA. The SSE Division tracks all lower level corrective actions based on events of a systemic nature or ones that present as an IDLH hazard. A tracking matrix is used which includes item description, requirement, comments, target completion date, actual completion date, risk ranking and the party responsible for completion. The responsible party signs the tracking sheet when a finding is closed and this information is transmitted for approval by the SSOA.

At the conclusion of the annual audit cycle, TriMet will prepare an annual audit report for submission to the SSOA. The report will detail the number of audits conducted for the year, progress made in reviewing each of the audit areas during the 3-year cycle, and the status of findings and corrective actions. The annual report will be transmitted to SSOA under the signature of the TriMet's Accountable Executive, affirming that TriMet follows its agency program plan. If the internal audits should find areas of non-compliance with the ASP or with safety regulations, the transmittal letter will indicate those actions taken to reach compliance.

External Agency Audits

Periodic audits are conducted by the FTA and/or ODOT. Following each audit, a Corrective Action Plan (CAP) is developed with the managers and directors who will provide documentation to resolve each findings and observations using the oversight agencies risk ranking guidance documents. All findings and observations from these audits are tracked to completion by the SSE Division as part of the CAP. Once an item is completed, the manager or director or their delegate must sign, indicating completion and that the proper paperwork has been submitted. The documentation is then submitted to ODOT for review, approval and final signature.

Facility and Equipment Inspections

For operations on the TriMet system, inspection and maintenance must be effective to assure that all systems, equipment, and facilities operate as required, or in the event of failure or degradation of functionality, that operational safety is not compromised. This aspect of inspection and maintenance directly pertains to the safety of TriMet customers, emergency response agencies, the public, and employees and subcontractors of TriMet.

Facility and equipment inspections must be effective in order to identify potential failures or degradation of operational safety early on. Inspections and maintenance of facilities and related equipment are performed in accordance with the manufacturer's manuals, codes, standards, and established procedures. The goal is to maintain a level of readiness that ensures safe, efficient and reliable transit service. Preventive maintenance activities on wayside equipment and other safety critical equipment are performed in accordance with the manufacturers' recommended practice and documented. Quarterly facility inspections are conducted at each maintenance facility to detect and eliminate hazards. The inspections are conducted by the SSE Division with the assistance of maintenance staff and safety committee members. Each facility is visually inspected for compliance with regulations and conformance to TriMet policies. Findings are assigned to the responsible party for resolution. Any findings from the inspection are verified and tracked to completion by the appropriate safety committee.

Signals shacks and traction power substations are inspected monthly by qualified technicians. This information is tracked in TriMet's Maintenance Management Information System (MMIS) database. Any defects are corrected immediately or scheduled for correction. MMIS records remain open until corrective actions are completed. Annual safety inspections are made of administration buildings and break rooms to detect and eliminate hazards to ensure the safety of passengers and employees using TriMet facilities. Any findings are assigned to appropriate parties and tracked to completions by SSE Division. In addition, each TriMet facility is inspected by the Fire Department, annually. Any findings are corrected by Facilities and tracked by SSE Division. The Maintenance of Way department conducts visual inspection of the alignment and records any defects in MMIS. Defects may be corrected immediately, or scheduled. MMIS records remain open until corrective actions are completed. The Maintenance Department maintains databases to track scheduled inspection and maintenance of vehicles and equipment. An active log is maintained by Rail Equipment Maintenance of all in-service failures and this is recorded in SMIS. Although such failures may not necessarily lead to an incident or accident, all "in service" failures are documented for review and for determination of the causal factors. Corrective action of "in service" failures are coordinated with the various Rail Operations departments and the SSE Division, as appropriate. Safety critical equipment that does not meet established requirements is required to be withheld from service. Vehicles or equipment involved in an accident are inspected by qualified personnel prior it to being placed back into service.

Inspection of rail systems, buses, light rail vehicles, and facilities are made in accordance with appropriate maintenance manuals and procedures. The SSE Division monitors accident reports and audits maintenance records to ensure equipment and facilities are maintained at an optimum level of safety. Documentation that may be audited includes SMIS reports and MMIS records. MMIS is the primary recordkeeping system used to store maintenance records. Findings from audits are tracked to completion in the SMIS. Deficiencies noted during inspections are documented and retained by the SSE Division. These deficiency reports are sent to applicable managers and responses are tracked by SSE Division and/or the Safety Committees until completed.

Maintenance Audit and Inspection Program

Inspection and maintenance of TriMet operating systems must be effective to ensure that all revenue and non-revenue vehicles, wayside systems, and equipment operate as required, or in the event of failure or degradation of functionality, that operational safety is not compromised. This aspect of inspection and maintenance directly pertains to the safety of TriMet customers, emergency response agencies, the public, and employees and subcontractors of TriMet. Implementation of inspection and maintenance activities is under the direction of MOW for fixed plant equipment, track, signals, communications, overhead contact system, other wayside equipment, and the Rail Equipment Maintenance Department for LRVs, non- revenue vehicles, and other support equipment. These departments closely coordinate their actions with Rail Transportation and the SSE Division.

Inspection and maintenance of all vehicles, equipment, and wayside systems are performed in accordance with manufacturers' manuals, codes, standards and established procedures. The goal is to maintain a level of readiness that ensures safe, efficient and reliable transit service. Preventive maintenance activities on LRVs, vehicles, wayside equipment, and other safety critical equipment are performed in accordance with manufacturers' recommended practice and are documented.

Maintenance of Way, Bus Maintenance and the Rail Equipment Maintenance Departments maintain a database, called MMIS, to track scheduled inspection and maintenance of vehicles and equipment. Preventative Maintenance (PM) is done by checklist, with defect either fixed immediately, or entered into the MMIS system to be tracked to completion. The MMIS system can be searched by vehicle or defect to ensure that items are not overlooked in the system. As PMs are due, MMIS is searched for any defects on the vehicle; PMs for buses and trains are based on mileage, which is checked twice per week. In addition, Maintenance of Way and Bus Maintenance use a "pending work" list, which is a part of MMIS. This is used for items that cannot be immediately repaired. These lists are reviewed by the Supervisors to ensure completion of all work. An active log is maintained by Rail Equipment Maintenance of all in-service failures on rail equipment recorded in SMIS. Although such failures may not necessarily lead to an incident or accident, all "in service" failures are documented for review and for determination of the causal factors. Corrective action of "in service" failures are coordinated with the various rail operations departments and SSE Division, as appropriate. Safety critical equipment that does not meet established requirements is required to be withheld from service. Vehicles or equipment that are involved in an accident are inspected by qualified personnel prior it to being placed back into service.

TriMet's Internal Audit Department provides independent assessments of maintenance and inspection programs. Deficiencies identified by the Internal Audit Department are reported to management and the deficiencies are tracked to completion.

Reference: 49 CFR Part 673

https://www.federalregister.gov/documents/2018/07/19/2018-15167/public-transportation-agency-safety-plan

TriMet Configuration Management Policies:

Reference: Emergency Operations Plan (EOP) and Continuity of Operations Plan


Emergency Operations Plan (EO


TriMet COOP 2019 (Final Draft).docx

Reference: State Safety Oversight Elements within ASP

	Element	Section
1	Policy Statement	TriMet ASP Policy Statement
2	Goals and Objectives	TriMet ASP Policy Statement & 1.3 Safety Goals
3	Management Structure	Reference Section: TriMet and Operations Organization Chart
4	ASP changes	673.11 (5) Review and Update of ASP
5	Implementing the ASP	TriMet ASP Policy Statement
6	Hazard Management Program	673.25 Safety Risk Management
7	System Modification Review and Control	673.27(c) Management of Change
8	Safety Certification	673.27(c) Management of Change
9	Safety Data Acquisition / Analysis	673.27(b)(4) Internal Safety Reporting Program Monitoring
10	Accident Notification, Investigation, and Reporting	Reference Section: Rail Accident Investigation Procedures
11	Emergency Management Program	673.11(6) Emergency Management Program
12	Internal Safety Review	673.27(b) Safety Performance Monitoring and Measurement
13	Rules / Procedures Compliance	673.29(a) Safety Training Program
14	Facility Inspections	673.27(b) Safety Performance Monitoring and Measurement
15	Maintenance Reviews / Inspections (All System & Facilities)	Reference Section: Operations and Maintenance Departments
16	Training and Certification	673.29(a) Safety Training Program
17	Configuration Management	673.27(c) Change Management
18	Safety Requirements	673.29(b) Safety Communication
19	Hazardous Materials Program	673.29(b) Safety Communication
20	Drug and Alcohol Abuse Programs	673.27 (b)(4) Internal Safety Reporting Program Monitoring
21	Procurement	673.25(d) Safety Risk Mitigation
22	Personal Electronic Devices	673.29(b) Safety Communication
23	Roadway Worker Protection	673.29(a) Safety Training Program

Reference: TriMet System Description

The District is responsible for providing safe, reliable, and efficient bus transit and paratransit service in the urbanized areas of Multnomah, Washington, and Clackamas counties, and light rail transit (LRT) service through the cities of Gresham, Portland, Beaverton, Milwaukie, Clackamas County and Hillsboro, Oregon. Service is also provided to the Portland International Airport.

Washington County Commuter Rail provides service between Wilsonville and Beaverton, utilizing existing freight trackway.

This following presents a brief history of light rail system development, a summary of the modes of service, and an overview of TriMet facilities and vehicles.

1. Light Rail Transit History and System Description

In March of 1982, work began on the construction of a 15-mile light rail system between the Cities of Portland and Gresham. This segment, known as the Banfield alignment, opened in September 1986.

In September 1997, the first segment of an 18-mile extension, known as the Westside Project, opened for revenue service. The project continued light rail transit service from the former terminus in downtown Portland to the west. The opening also marked the introduction of low-floor light rail vehicles in North America.

In September 1998, revenue service was initiated, on the remainder of the Westside extension, through Washington County to the cities of Beaverton and Hillsboro. In conjunction with the opening of this extension, bus transit service was greatly expanded within Washington County.

In September 2001, the Airport MAX extension opened providing service from the Portland International Airport (PDX) to Downtown Portland.

In May 2004, the Interstate extension opened. The Interstate Max extends the system from the Rose Quarter to the Portland Expo Center.

In September 2009, the Green Line extension opened. This extension provides rail service from Clackamas Town Center into the downtown area.

The latest addition to the light rail network is the Portland to Milwaukie extension, which connects downtown Portland to Clackamas County via the City of Milwaukie. This extension opened in September 2015.

Operations

Light rail transit (LRT) service is provided seven days a week from approximately 4am to about 2am. The service design is based on 15-minute headways throughout the LRT system. 15-minute headways are provided until about 10:30 PM when there is a transition to 30-minute headways. Base operations employs two-car consists on all lines, all days.

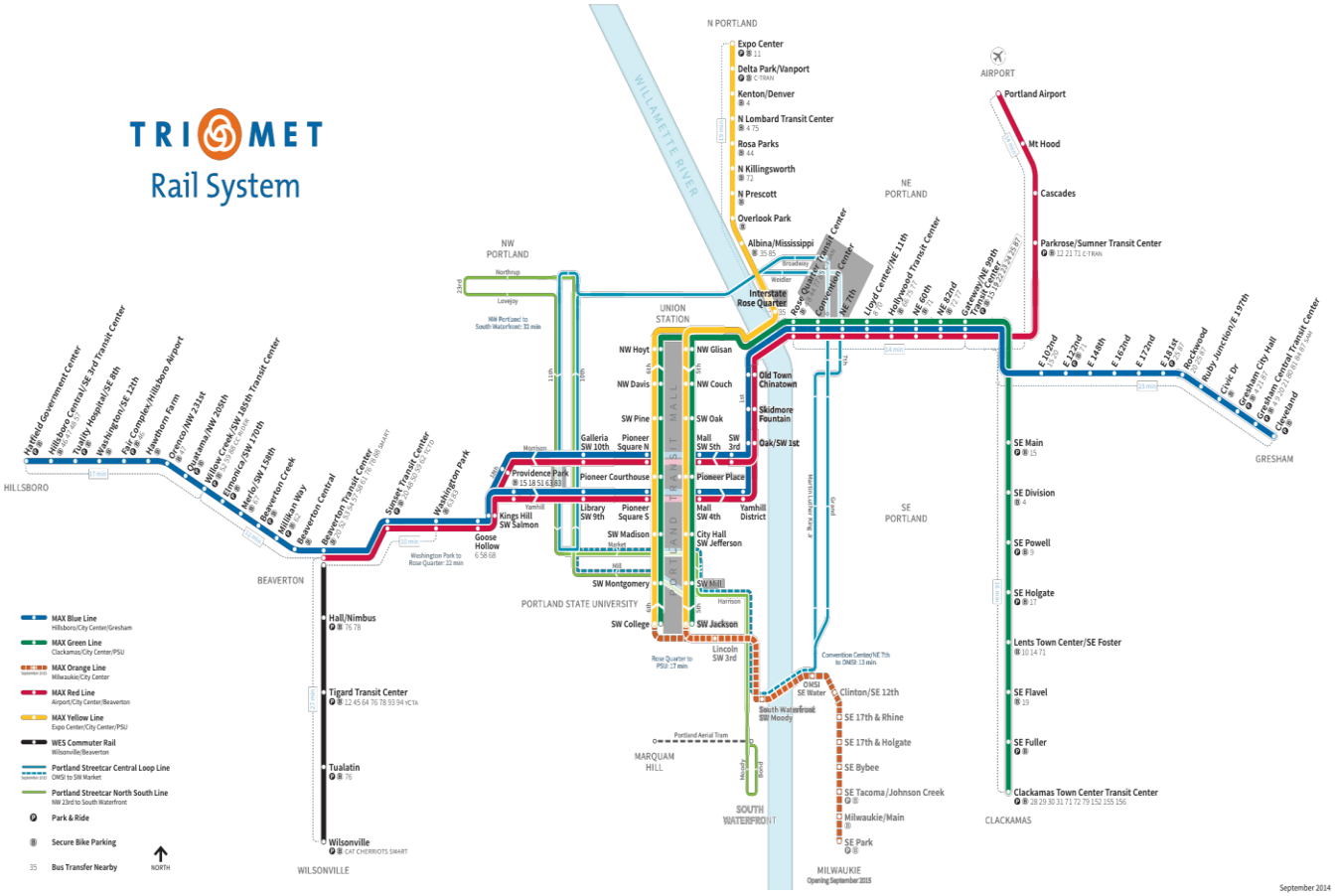
Currently, there are over 123,700 boardings daily on the Blue, Red, Green, Orange, and Yellow lines. The Rail Operating Rule Book and SOPs are the references for rail operations. The Rule Book and SOPs

also provide Rail Operators with specific instructions to be followed in the event of an emergency. The Rule Book and SOPs are revised as needed.

Alignment and Routes

TriMet's light rail system has expanded over the years and is now comprised of several service lines. The light rail system has over 60.2 miles of revenue track operating through the cities of Portland, Beaverton, Gresham, Milwaukie, and Hillsboro and unincorporated Clackamas County, Oregon. The downtown Central Business District (CBD) is the center of the system. All five lines provide service to stations in the CBD. The Green and Yellow Lines operate on the Transit Mall on 5th and 6th Avenues, the Red and Blue Lines operate on the "crossmall" alignment on Morrison and Yamhill Streets. The Orange Line terminates at the Jackson Turnaround and transitions to the Yellow Line.

The service lines are referred to by color and are coordinated with TriMet's bus service. Transit Centers, Park and Ride lots and Quick Drop parking spaces are provided along the service lines and support the service. The service lines and a brief description of each are indicated below.



Blue Line

The Blue Line route is the oldest and longest on the system beginning revenue service in 1986, now with an overall length of 33 miles. The Blue Line is comprised of the 15-mile Banfield segment and the more recent 18-mile Westside segment. The Blue Line route starts at the Cleveland Terminus station in Gresham and serves 50 passenger Stations ending at Hatfield Government Center in Hillsboro. Several of the Stations include Park and Rides and/ or Transit Centers. The Blue Line has yard leads that connect both Ruby Junction and Elmonica Maintenance Facilities to the entire system.

The eastern terminus of the light rail line is located at NE Eighth Avenue and Cleveland Avenue in Gresham, Oregon. From this point, the line runs in a westerly direction for 2.1 miles over the former right-of-way of the Portland Traction Company to Eleven-Mile Avenue. This area is designated as an exclusive right-of-way with periodic grade crossings and train speeds approaching 55 mph. The line continues westward within the median strip of East Burnside Street for 5.3 miles between Eleven-Mile Avenue and 97th Avenue. This area is considered semi-exclusive right-of-way and street crossings are controlled by standard traffic signals. Trains in this area operate at 35 mph. At 97th Avenue, the route turns north for 0.6 miles paralleling Highway I-205 between Burnside and Gateway. This area is exclusive right-of-way with train speeds of 35mph. Turning west and crossing over the I-205 and I-84 freeways, the line runs in a completely grade separated section, between the rights-of-way of the Banfield Freeway and the Union Pacific Railroad, from the Gateway Transit Center Park and Ride, to 13th and Holladay for 4.9 miles. Train speeds within this segment reach 55 mph. At street level, the route follows Holladay Street on a side-aligned, restricted portion of the street for 0.7 miles. This is semi-exclusive right-of-way controlled by standard traffic lights. Trains operate at speeds of up to 25 mph. The line crosses the Willamette River via the Steel Bridge, sharing the roadway space with vehicular traffic. The tracks descend the bridge at Everett Street to NW First Avenue, into downtown Portland. The line continues south, traveling both ways in the median and side aligned on NW First Avenue in semi-exclusive and pedestrian mall types of alignment. The speed in this area is typically 15 mph. At Morrison Street, the line turns west to 11th Avenue, the former terminus of the original LRT line. In this segment, from 1st Avenue to 11th Avenue, the trains operate one way on the left side of the street, parallel to vehicular traffic. Outbound service is on Morrison Street. Inbound service is one block south on Yamhill Street. The 11th Avenue Terminus has three tracks connecting Morrison and Yamhill and is still used by various trains operating on the Blue and Red lines. In the downtown segment of the alignment, light rail tracks are not physically separated from vehicular traffic lanes but are differentiated by pavement treatment and rumble strips. Motorists are not permitted to drive on the tracks between crossings. Crossings are controlled by standard traffic lights. Train speeds typically operate at 15 mph in the downtown segment.

The next segment of the Blue line begins the extension opened to revenue service in 1998. This segment of the light rail alignment continues west, from the former terminus at SW 11th Avenue, westbound along SW Morrison Street, and eastbound on SW Yamhill Street. At the block bounded by SW Morrison Street and SW Yamhill Street, and SW 17th Avenue and SW 18th Avenue, the alignment turns south, and extends down the median of SW 18th Avenue to Collins Circle. As in the eastside, downtown segment of the alignment, the light rail tracks are not physically separated from vehicular traffic lanes but are differentiated by pavement treatment and rumble strips. Motorists are not permitted to drive on the tracks. Crossings are controlled by standard traffic lights. Train speeds typically operate at 15 mph. At Collins Circle the routes turns west, down the south side of SW Jefferson

St. This segment is designated as semi-exclusive right-of-way and crossings are controlled by traffic lights. After passing under SW Canyon Road, trains enter a 3-mile tunnel. One subsurface station is located in this segment, at Washington Park/Oregon Zoo. The western tunnel portal is located adjacent to the Sunset Highway, at approximately SW 76th Avenue. This is exclusive right-of-way in a tunnel environment. Train speeds approach 55 mph. The rail line continues along the north side of the U.S. Highway 26 (Sunset Highway) to the northwest sector of the Highway 217 interchange. This area is a continuation of the exclusive right-of-way and train speeds approach 55 mph. The Sunset Transit Center Station and adjacent Park and Ride are located at the Highway 217 interchange. The line crosses under the Sunset Highway and continues along the Westside of Highway 217 to SW Cabot Street. At SW Cabot Street, the rail line turns west, passes by the north side of the Canyon Place Shopping Center, and enters the north side of the Beaverton Transit Center. This portion of the alignment is designated as exclusive right-of-way, except for two gated grade crossings at 114th Avenue and 117th Avenue. Train speeds approach 35 mph in this area.

The route continues west, crossing SW Hall Blvd. and SW Watson Avenue before joining the former Burlington Northern Railroad (BNRR) alignment. The Willow Creek Transit Center and adjacent Park and Ride are located at SW 185th Avenue. The rail line continues west, along the BNRR alignment, for approximately 6.2 miles to the intersection of SE 12th Avenue and Washington Street in Hillsboro. This area is designated as exclusive right-of-way with periodic grade crossing protected by crossing gates. Train speeds approach 55 mph in this segment. The light rail route extends from SE 12th Avenue through downtown Hillsboro along Washington Street to the end of the alignment at Government Center, just west of 1st Avenue. This is area is considered as non-exclusive right-of-way with mixed traffic. Auto traffic is permitted to make left turns from the LRT trainway. Crossings are controlled by standard traffic lights and train speeds approach 20 mph.

Red Line

The Red Line began revenue service in September 2001 and extended service from Gateway Transit Center north 5.5 miles to the Portland International Airport. The Red Line route starts at Portland International Airport and serves 4 stations before joining the Blue Line route were it serves 24 passenger stations along the Banfield, CBD and on out to Beaverton before reaching the turn back at Beaverton Transit Center. The Red Line serves the Parkrose Transit Center on its extension.

The Red Line begins as a single-track section, just south of the Gateway Transit Center, that initially heads south at grade then enters into a sharp curve that crosses over the I-205 multi-use path and vehicle connector ramps between I-205 and I-84. Due to the configuration of the Loop Bridge train speeds have been restricted to 10 mph. The single-track segment continues to just north of the I-84 overcrossing where it turns into a double track configuration. The area from the Loop Bridge through Rocky Butte and the existing cut and cover under the northbound lanes of I-205 is all protected right-of-way. Protective fencing separates the LRT from the pathway and existing fencing along I-205. Trains typically operate at 50 mph through this segment. The route continues from the cut and cover box into the center median of I-205 and continues on to the Parkrose Station's center platform. Train speeds typically will operate at 55 mph through this segment. A walkway form the North end of the station's platform rises to meet a pedestrian bridge over the northbound lanes of I-205 to the existing Parkrose Park and Ride. North of the Parkrose Station, the rail line continues at grade in the median crossing under Columbia Blvd. and the UPRR Bridge. Just before the I-205 freeway crossing of the Columbia Slough. The flyover bridge begins to elevate to cross over the southbound lanes of I-205. Train speeds on the fly-over bridge will typically be 35 mph. Trains service two side platforms in the Cascade Station

Development, Cascades and Mt. Hood, before making the final stop at the Portland International Airport. There is a single-track segment between the area of the Airport Post office and the terminal station. The west end of the LRT station platform is approximately one hundred feet east of the entrance into baggage claim area on the ground level. The track section leading into the Terminal Station has 5 speed trip zones controlled by ATS equipment and bumping posts are installed at the terminus. Speed restrictions into PDX Terminus begin at 30 mph and step down at 5 mph increments to 10 mph.

Yellow Line

The Yellow Line began revenue service in May 2004 and extended service from Rose Quarter Transit Center north 5.8 miles to the Portland Expo Center. The Yellow Line route starts at Portland EXPO Center and serves 10 passenger stations along its route, before joining the Green Line route through the CBD before reaching the turn back at Jackson. The Yellow Line has two Park and Rides on its extension.

The Yellow Line goes northward, just west of the existing Rose Quarter Transit Center, within a median strip of North Interstate Avenue between Multnomah Avenue and Fremont Avenue and is predominantly tie and ballasted track with segments of paved track. This area is considered semi-exclusive right-of-way and street crossings are controlled by standard traffic signals. Trains in this area operate at up to 35 mph. The second segment of the line continues northward within a median strip of North Interstate Avenue between Fremont and Fenwick Avenue and is paved track. This area is also considered semi-exclusive right-of-way, with only authorized emergency vehicles allowed to enter the raised paved track alignment. Street crossings are controlled by standard traffic signals. Trains in this area can operate at up to 30 mph. At Fenwick the yellow line make the transition from center to side running and continues north just one more block at which time it enters a dedicated elevated light rail bridge structure called the Vanport Bridge. Trains reach operating speeds up to 55 mph in the long bridge section. The last section of the Yellow Line runs in an exclusive right-of-way, between the rights-of-way of the I-5 Freeway and EXPO Road in a tie and ballasted track section. Trains service side platforms at Delta Park before making the final stop at the Portland EXPO Center Station. The track section leading into the EXPO Station has speed restricted curves controlling approach speeds and bumping posts are installed at the terminus. Train speeds within this segment reach 35 mph.

Green Line

The Green Line began revenue service in September 2009. The Green line route starts at Clackamas Town Center, through Gateway, and into the CBD. In the CBD, it travels north/south from Union Station to Portland State University. Approximately 8.6 miles of track were added for this project.

The I-205 Segment of the Green Line extends south along the I-205 corridor from approximately 1600 LF south of TriMet's existing Gateway Transit Center for 6.5 miles to the Clackamas Town Center. It includes eight stations and five parking facilities. The double-track, I-205 light rail extension begins at the north end with a fully interlocked double crossover that ties the I-205 segment into the existing Blue Line. Gateway Transit Center is on the Blue and Red Lines at the juncture of I-205 and I-84. At Gateway Transit Center, the two existing lines and the new I-205 line share the existing passenger boarding platforms. The I-205 light rail extension parallels TriMet's Blue Line just north of Burnside Street where the Blue Line turns east. The I-205 alignment continues south on the east side of the freeway, passing under the overpass at Burnside. Two cut and cover box structures have been constructed under Stark and Washington Streets just to the east of the existing off-ramps. The alignment continues at grade

1600 LF to the first station and surface Park & Ride facility, located adjacent to Main Street and the Main Street pedestrian overpass. From Main Street, the extension continues south through an at-grade gated crossing (Main Street Park & Ride access road) and pass under the Market Street overpass. The alignment then curves slightly west and passes through an existing 450 LF transit way box structure through which the alignment transitions from the east to the west side of I-205. The extension continues at grade within an existing transit way corridor on the west side of I-205. The I-205 extension continues under the Division Street overpass to a second station just south of the Division Street overpass. It then continues south onto a new structure crossing over Powell Boulevard to a station and surface Park & Ride facility south of Powell. South of the Powell Station the extension proceeds at grade to an at-grade station and surface Park & Ride facility north of Holgate Street. Progressing south, the alignment passes under the existing Holgate overpass and continue 2600 LF on grade to Harold Street, where it will cross on an overpass. An at-grade station is located north of Foster Road. Upon leaving the station, the alignment crosses SE Foster Road and SE Woodstock Boulevard on structure. North of SE Foster Road, the light rail alignment is generally located within the existing transit way constructed by ODOT in conjunction with I-205. No designated transit way exists south of SE Foster Road.

South of SE Woodstock Boulevard, the alignment is generally located between I-205 and the existing multi-use path. 2000 LF south of Woodstock, the extension crosses the Springwater Corridor on a new overpass. The alignment continues south over Johnson Creek on a new structure and then across Flavel Street at grade with a gated crossing, to the next station, at-grade just south of SE Flavel Street. The alignment continues south along I-205 and ascends on fill to a structured crossing over SE 92nd Avenue/SE Crystal Springs Boulevard intersection. The descent from the intersection to grade occurs approximately 850 LF south, with the alignment continuing at the base of the I-205 berm, next to the existing bike path. The I-205 extension continues along the base of the existing berm at grade for roughly 2000 LF where grade separation begins for the crossing of SE Johnson Creek Boulevard on an overpass structure, located to the west of the existing I-205 ramps. A station and surface Park & Ride lot are located south of Conn Battin Road, after which the alignment descends to freeway grade and passes underneath the existing SE Otty Road overcrossing. The alignment continues at grade, between I-205 and the bike path under the SE Monterey Avenue overcrossing. After the undercrossing, the alignment begins its final descent behind the Clackamas Corner shopping center to a terminus station and parking structure in the eastern Clackamas Town Center parking lot. The Clackamas Town Center Transit Center is located just south of the new parking structure with bus layovers on the ground floor of the garage. The Portland Mall segment of the Project establishes LRT on the existing bus mall on SW 5th and 6th Avenues. The alignment diverges from the existing system at the west end of the Steel Bridge and runs between NW Glisan St. and the Union Pacific Railroad to Union Station. Westbound trains then turn onto Fifth Ave. and travel south through the downtown core, traversing 26 blocks from NW Irving St. to SW Jackson St.

The alignment crosses the existing east/west LRT tracks at SW Morrison and Yamhill Streets and the Central City Streetcar tracks at SW Market and Montgomery Streets. Southbound trains turn around south of SW Jackson St. and proceed northward along Sixth Ave., traveling back through downtown to Union Station and then east to join the existing system at the Steel Bridge. The alignment serves the highest density land use in downtown Portland, including core retail and business centers and major service and entertainment centers such as Amtrak Union Station, Greyhound Bus Station, Pioneer Place Mall, Pioneer Square, Keller Civic Auditorium, Arlene Schnitzer Performing Arts Center and Portland State University.

The overall length of the Mall alignment is 3.4 miles of single track. Fourteen new stations were added (seven on Fifth Ave. and seven on Sixth Ave.), located at NW Hoyt St., NW Davis St., SW Stark St., SW Yamhill St., SW Madison St., SW Mill St., and SW College St.

Orange Line

The Orange Line, the newest light rail alignment, is an approximately 7.3 mile extension serving the CBD, the South Waterfront District, the Central Eastside Industrial District, Southeast Portland neighborhoods, the Milwaukie Town Center, and the urbanized portion of Clackamas County. The entire alignment is double-track to the existing regional light rail network. It adds 10 new stations, approximately 675 park-and-ride spaces, and an exclusive transit way between SW 1st Avenue and SE 8th Avenue as part of a new bridge across the Willamette River for pedestrians, bicycles, buses, light rail, and potentially streetcar in the future.

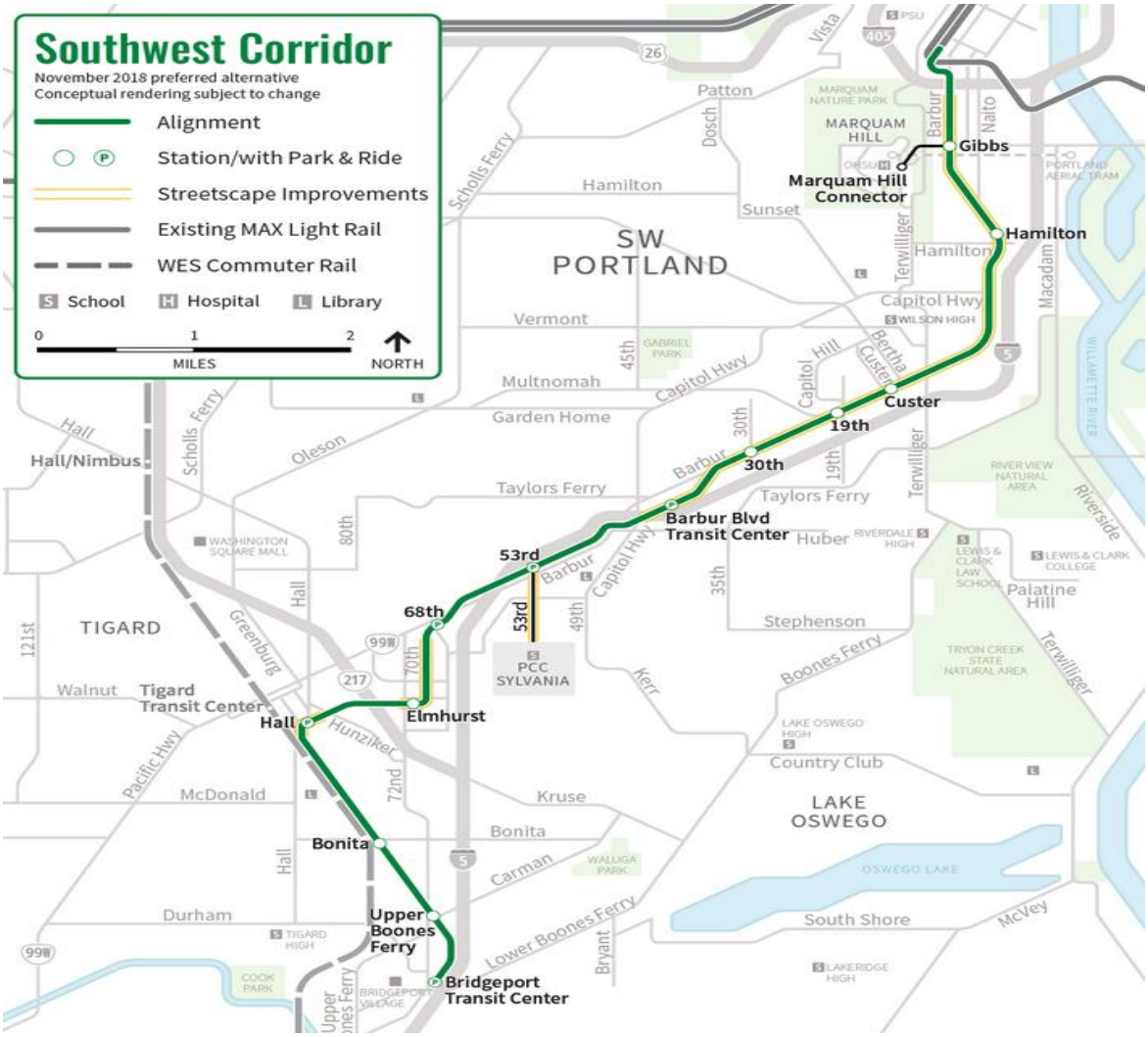
The extension connects with the Portland Transit Mall on SW 5th and SW 6th Avenues at SW Jackson Street and head east on SW Lincoln Avenue. Beginning at SW 1st Avenue, the alignment includes a transit way for buses and will veer south on an aerial structure generally along SW Moody Avenue to SW Porter Street in the South Waterfront District. A new bridge over the Willamette River, Tilikum Crossing Bridge, connects between SW Porter Street and SE Sherman Street adjacent to the Oregon Museum of Science and Industry (OMSI). From OMSI, the transit way portion of the alignment continues generally south of the Union Pacific Railroad (UPRR) to SE 8th Avenue.

The light rail alignment then continues along the UPRR to SE 17th Ave, where it heads south on SE 17th Avenue to SE McLoughlin Boulevard. From SE McLoughlin Boulevard at SE 17th Avenue, the alignment continues south on the eastern edge of SE McLoughlin Boulevard to SE Tacoma Boulevard, where it follows the Tillamook Branch of the UPRR to Lake Road in Milwaukie. The alignment then crosses Kellogg Lake and SE McLoughlin Boulevard, following that road south to its terminus at SE Park Avenue. Park-and-ride facilities are located at stations near SE Tacoma (320 spaces) Boulevard and SE Park Avenue (355 spaces). The SE Tacoma facility is a surface lot. The SE Park facility is a structured garage.

Southwest Corridor

The Southwest Corridor Light Rail Project will connect Downtown Portland and Tualatin with a 30-minute travel time and bring high-capacity transit to one of the region's most congested corridors. The project is in the early design phase and recently released the preliminary conceptual designs through the Conceptual Design Report. It describes and illustrates the overall urban design vision as well as the conceptual designs for stations, major structures, and other key corridor improvements.

Construction on the light rail project could begin as early as 2022.



Station Platforms

Stations generally consist of a platform or sidewalk extension, ticket vending and validating machines, shelters and information displays. Station platform lengths are limited to approximately 200 feet due to the size of city blocks in downtown Portland. Boarding height is low-level, approximately 10 inches above top-of-rail.

Well-lit, minimally obstructed platforms allow good visibility for passengers and TriMet personnel. Street level stations have safety bollards and fences to prevent the intrusion of vehicular traffic on to station platforms, and to reduce the tendency for passengers to cross tracks in other than designated areas. All stations are at street level except for Washington Park, Sunset Transit Center, and Parkrose Stations, and the three stations along the Banfield Freeway – Hollywood (42nd), 60th, and 82nd Avenues. The Washington Park Station is looked within the Robertson Tunnel.

Rail Operations and Maintenance Facilities

The center of operations for the light rail system is the Operations Headquarters facility. The facility is located in Portland, Oregon. The building houses the Executive Director Transportation, bus transportation staff, the Operations Command Center for bus and rail operations, report facility for bus operators, and facilities maintenance departments. These departments are responsible for bus and rail operations and field supervision. Rail transportation and maintenance staffs are located at the Ruby Junction Rail Facility in Gresham, Oregon and the Elmonica Rail Facility in Beaverton, Oregon.

Tracks, in the yard area surrounding the Ruby Junction and Elmonica facilities, provide space for the storage of light rail vehicles (LRVs) not in service, and enables movement of LRVs to/from the mainline and through the maintenance shop and car washer. A test track on the east side of the Ruby Junction yard allows testing of brake and electrical systems of LRV's following repairs and prior to placing back in service. Both Ruby Junction and Elmonica facilities have service pits, cranes and other equipment necessary for servicing and maintaining the rail vehicles. Catwalks allow access to the roof of the vehicles. There are storage spaces for spare parts and units required for the maintenance of rail facilities and equipment. The OCC, located within the Operations Headquarters facility, has the responsibility and capability to monitor and control operations of the rail system and to handle emergencies that might arise. The OCC is continuously staffed during all hours, 7 days a week. Communications equipment allows Controllers to speak directly with train operators, and maintenance personnel, as well as police, fire, and rescue personnel. The following functions are performed from the OCC:

- Create and distribute train orders and special instructions
- Monitor train movements and adherence to schedules
- Monitor and acknowledge signals, traction and electrical power, fare collection, communications, and elevator system status and alarms
- Provide 800 MHz radio communications with LRV operators and key staff to provide advance warning and coordination action with other agencies
- Provide telephone communications with key staff in yard, crew room, and in tunnel sections
- Initiate route requests to the signal system.
- Initiate requests to open DC feeder breakers
- Provide transit text messages via reader boards

Additionally, the OCC is able to supervise and control the following functions within the Robertson Tunnel:

- Initiate the operation of any of nineteen pre-defined ventilation operating modes as dictated by train direction of travel, fire zone and passenger evacuation direction planned
- Transmit requests to close specific fire doors on the Washington Park station platform
- Transmit requests to alter the elevator control mode
- Transmit a request to open the fire protection stand pipe flow valves
- Provide emergency communications with emergency responders via telephone
- Monitor the state of tunnel emergency control panels located in the Operations room at the Washington Park station
- Provide public announcements in the Washington Park Station

The Ruby West Vehicle Storage & Maintenance Facility is a 1-story, 2-bay repair facility for the maintenance and storage of non-revenue service vehicles. The facility includes an inspection bay and hydraulic lifts. Ruby West also includes a wash bay for the light rail vehicles.

MOW resides in the Ruby South building. Signals, Overhead Contact System (OCS), Substation, Landscaping and Rail Facility staff work out of this facility. This staff is responsible for maintenance of all systems that allow the train to operate. LRV Maintenance has a flat bay for metalwork. The body shop and paint booth is located in Ruby South. The facility has service pits, cranes and other equipment necessary for servicing and maintaining the rail vehicles. Catwalks allow access to the roof of the vehicles. In addition, this facility has a paint booth.

The Elmonica Operations Facility is a mixed-use building with office space and an LRV maintenance area. The building houses rail operations staff, report facility for train operators, and maintenance of way (MOW) and rail equipment maintenance staff. The maintenance area consists of maintenance bays, in-floor vehicle jacks, storage tracks, a blowdown pit, and a wash bay. Catwalks allow access to the roof of the vehicles. The building is covered by a complete automatic fire sprinkler system. The yard area surrounding the operating facility contains the trackage that provides the space for storage of cars not in service and enables movement of vehicles to and from the mainline and through the maintenance shop and car washer.

Track

There are three general types of track and special appurtenances utilized on the TriMet system.

- Ballasted Track, comprised of 115 lb. AREA rail installed on either timber or concrete ties placed in a ballast track bed. This type of track may include short walls to contain the ballast. Drainage can include underdrains or trackside ditches. The rail is fastened to the ties with track spikes or I spring clips (Pandrol clip). This type of track is utilized on the private right-of-way portions of the mainline. Ballasted track is also typically used to construct storage tracks at the maintenance facilities.
- Direct Fixation Track consists of 115- lb. AREA rail fastened directly to cast-in-place track plinths. The rail rests on resilient plates, called direct fixation fasteners, which are in turn fastened to the plinths through the application of bolts. This type of track is used in selected areas of at-grade private ROW and viaduct structures. Track in TriMet's Robertson Tunnel is a variation of direct fixation track that utilizes precast concrete blocks instead of direct fixation fasteners.
- Embedded Track. This track consists of 115-lb. AREA rail, or Ri 59 girder rail. The rail is encased in a rubber boot or elastomeric rail support material and embedded in concrete. This type of track is primarily utilized in locations where "in-street" running occurs.
- Crossover tracks and pocket tracks are located at suitable locations to permit trains to turn back at both ends of the system and at selected mid-line locations. Terminal and pocket tracks are used for holding spare vehicles during special events, and provide capability for the temporary storage of malfunctioning trains.

Tunnel

The tunnel is a twin-bore; the two bores are connected by 19 cross –passages located approximately 750 feet apart from each other. Each cross-passage is protected by 2 pairs of double egress 1-1/2 hour fire rated doors with exit devices. A 30-inch (minimum) wide walkway at 10 inches above top of rail (TOR) is provided on the inside (left side) of each tunnel bore for routine maintenance access and emergency egress.

The standpipe system has fill points at the Washington Park Station head house and the West Vent shaft building, which can be filled locally or remotely from the Washington Park or the Ruby Junction Command Center. Emergency lighting is provided to permit passenger egress from the station and tunnel areas during a loss of utility power.

The station consists of two 200 feet long platforms connected by diagonal cross passages and elevator lobbies at the east and west ends. Platform lobby areas and diagonal cross passages are equipped with fire rated doors on each side. The OCC remotely controls the doors. During an emergency, the doors to the incident platform are closed to isolate it, and keep smoke and heat away from the non-incident platform areas. Two vertical shafts connect the platform level with the head house structure at the surface. Each shaft includes two high-speed elevators, station air ducts, tunnel ventilation fan ducts, and exit stairs. The head house structure includes the elevator entrances, fan rooms, electrical rooms, and an Operation Room. The Operations Room supplements some of the control functions of the OCC at Ruby Junction and will be use during emergency incidents and during high station use periods.

The Operations Room is an emergency control center located within Washington Park Station. TriMet and emergency response personnel staff the room during emergency incidents. It may also be staffed during high station use periods. If communication is lost between Ruby Junction and the tunnel, a Supervisor is dispatched to the Operations Room and will remain on site until communications have been restored. In the event that any of the Tunnel Fire/Life Safety and Security equipment needs to be activated, the Supervisor on site will do it through the onsite control panels.

Tunnel Ventilation

The goal of the tunnel and station ventilation system in a fire or smoke emergency is to:

- Assist in the safe evacuation of passengers from a disabled train and provide emergency personnel with access to the site, by controlling the movement of both smoke and heat
- Supply outside air in the evacuation path and provide airflow in sufficient quantities to prevent back flow of hot, smoke-laden air
- Facilitate purging of smoke after a fire or smoke incident

An electronically supervised and zoned fire detection alarm and control system serves the Washington Park station and the West Ventilation shaft. The system consists of a Fire Management Panel, a Fire Alarm Relay Panel, and other support equipment/devices such as manual alarm pull station, smoke and heat detectors, elevator recall, gaseous fire suppression systems, sprinkler water flow switches, fire water valves and fire door release.

Light Rail Vehicles (LRV)

TriMet operates the light rail vehicle fleet to handle the ridership demands. The light rail vehicle fleet consists of self-propelled, six axle, articulated, electrically powered rail cars. Each car is completely equipped for bi- directional operation except for the Type 4 and Type 5 LRVs. The vehicles are capable of multiple unit operation of up to four cars, using any combination of cars, except for the Type 4 and Type 5 LRVs, of which only two may be coupled. Operations, however, are restricted to two cars due to the short blocks in downtown Portland. The vehicles are powered by means of an OCS, which supplies 750 volts DC electricity to power the cars. The light rail vehicles are capable of speeds up to 55 mph, with an average speed of 21 mph. The light rail cars are designed to be "fail safe" so that failure of any safety critical component automatically stops the train or causes it to run at a safer, more restrictive speed. Train design prevents car movement if a side door is not closed and locked. Passengers, however, can open car doors to disembark a train during an emergency. Additionally, in the event the operator fails to regain control of the light rail vehicle the "dead man" feature is activated; an irretrievable brake application is initiated.

Fire resistant materials are used throughout the cars and fire extinguishers are provided. Emergency battery power provides communication, emergency car lighting, and headlights and taillights if traction power is lost. The on-board public address system allows the Operator to communicate emergency instructions or other information to passengers inside or persons outside the vehicle.

Description	From	To	Mfr	Yr	
Type I	High Floor Light Rail Vehicles	101	126	Bombardier	1983-86
Type II	Low Floor Light Rail Vehicles (LFLRV)	201	252	Siemens	1995-99
Type III	Low Floor Light Rail Vehicles (LFLRV))	301	327	Siemens	2002-04
Type IV	Low Floor Light Rail Vehicles (LFLRV)	401	422	Siemens	2008-09
Type V	Low Floor Light Rail Vehicles	501	518	Siemens	2015

Total LRV Fleet = 145

Traction Electrification System (TES)

A nominal 750-volt direct current (VDC) traction power system, consisting of a power conversion and distribution system, provides propulsion to the light rail vehicles. High voltage alternating current (12.5 kVAC) is converted to 750 VDC at substations and is then fed through protective switching equipment to the distribution system. The distribution system is composed primarily of a contact wire above each track, together with associated feeder cables, support poles, and other components. To provide power reliability, adjacent substations supply each segment of contact wire with electrical power.

The OCS consists of all equipment from the interface with the traction power substation positive feeders to the interface with the light rail vehicle pantograph. All OCS equipment is energized at a nominal 750 VDC, and is double insulated. A minimum of two levels of electrical insulation is provided between the contact wire and a line pole or other grounded structure. The OCS system includes the following types of configurations:

Single contact fixed termination system consists of a single contact wire with fixed terminations. The contact wire is supported by t cross-spans, headspans, cantilevers, and shop supports. This system is used in the maintenance facilities and storage yards and interfaces with the simple auto tensioned catenary on the yard lead tracks.

- Weight tensioned single contact wire or trolley wire system consists of a single contact wire tensioned by means of counterweights or spring tensioners and supported from cross-spans by rollers and bridles or from cantilevers, This system is used exclusively in the downtown Portland CBD and downtown Hillsboro (10th Street to Government Center) environments.
- Simple fixed termination catenary system consists of both a contact and messenger wire with fixed terminations. This system interfaces with the single contact wire auto tensioned system near the East Portal of the tunnel, and continues through the 3-mile tunnel interfacing with weight tensioned catenary system in the West Portal area. The catenary is supported from cantilevers and tunnel roof supports.
- Simple auto tensioned catenary system consists of both a contact and a messenger wire tensioned by means of counter weights. Messenger wire is suspended from cantilever arms, headpans, or bridge supports. The contact wire is supported from the messenger wire by hangers at regular intervals to produce a contact surface nearly parallel to the top of the rails. The route covered by this type of catenary system is mainly open track. This system runs from the terminus in Gresham to Rose Quarter, where it interfaces with the auto tensioned single contact wire system. The system resumes west of the tunnel and continues to 10th Avenue in Hillsboro. Additionally, the 5.5-mile Airport MAX extension, the 5.8-mile Interstate MAX extension and the 6.6-mile I-205 Green Line extension employ this system type.
- Some modifications to these common systems include the catenary system at Sunset Transit Center, which has been modified to accommodate the cut and cover box and tight radius curve, with the inclusion of messenger and contact wire tension reducers for each track at the beginning and end of the area. A double crossover incorporates a single fixed termination contact wire system because of clearances and wiring arrangements. The catenary arrangements at Rocky Butte Tunnel and Greeley overpass employ parallel contact wires in limited clearance areas.

15kV System

The 15kV system provides power for running the trains and all systems within the tunnel. The system includes:

- Approximately six miles of multi-conductor, metal-clad cable throughout each of the two tunnel tubes and up the vertical shafts at the West Vent Shaft and Washington Park Station
- Multiple sections of metal-clad switchgear at the East Portal, West Portal, West Vent Shaft and Washington Park Station
- A 750kVA single-ended unit substation at the West Vent Shaft and 2000 kVA double- ended unit substation at the Washington Park Station.
- A unit substation at the Sunset Transit Center

All TES substations have DC breakers and separate disconnect switches for individual track sections. Various AC and DC circuit breakers protect substation equipment. When a fault or overload occurs, circuit breakers and relays operate automatically to disconnect power instantaneously. Additionally, the circuit breakers and relays can be controlled from panels within the substations. If a fault occurs on the AC side of the equipment, the feeders disconnect. Normal operation, however, can be maintained with the DC breakers closed, acting as a tie station. Battery backup for ten hours is provided for control equipment in the substation, in the event of loss of supply power.

The Operations Command Center can remotely open the DC circuit breakers at each TES substation to isolate each electrical section. For safety reasons, these breakers cannot be remotely closed. They must be manually closed by qualified technicians. The DC circuit breakers that feed each electrical section within the tunnel, however, can be opened and closed remotely by the Operations Command Center or at the operations catenary control panel located at the Washington Park Station. Additionally, each substation has an emergency shutdown disconnect that opens the AC and DC breakers, and transfers the signal to the adjacent substations causing the OCS to be disconnected from the power supply. The emergency shutdown disconnect can only be activated at the substation itself.

To provide operational flexibility, the overhead is divided in sections, which are separated by section insulators, insulated overlaps or airbreaks. Pole mounted switches near the section insulators enable the power from a specific section of track to be de-energized.

Signal System

Railroad signal techniques are used to enhance safety and improve efficiency in the operations of trains. Circuit design conforms to the "American Railway Signaling Principals and Practices" of the AAR Communications and Signals section. Signal system functions include:

- Protection and control of track switches
- Protection and control of bi-directional train operation
- Protection for following trains operating with the normal current of traffic
- Highway grade crossing warning

The signal system includes:

- An automatic block signal (ABS) system to satisfy both present and future headway requirements.

- An automatic train stop (ATS) system that automatically applies the train-braking systems if a train passes a red signal.
- Train to wayside communications (TWC) system to:
- Automatically call routes through interlockings
- Update the Operations Command Center computer system as to the locations of light rail vehicles
- Pre-empt intersection traffic control signals
- Call (request for routing) switches in TriMet's Ruby Junction and Elmonica Operations Facility yards.
- Speed control zones, where train entry speed into sharp curves and/or passenger stations is controlled and enforced by the use of Automatic Trip Stops.
- Grade crossing warning systems at highway grade crossings.

The purpose of the ABS system is to automatically control train operations and provide safe clearances and stopping distances in areas of high-speed train operations (Up to 55 mph). The ABS system is used in the following segments:

Blue Line	• Eleven-Mile Avenue to the Gresham Terminus • Lloyd Center Station to Gateway Transit Center, along the Banfield Freeway • East Portal of Robertson Tunnel to Hillsboro
Red line	• System extension from Gateway Transit Center to Portland International Airport
Yellow line	• System extension from Rose Quarter to Albina • Kenton to Expo
Green Line	• Gateway to Clackamas Town Center
Orange Line	• Holgate Ave to Park Ave

Continuous track circuits throughout the block and an area (overlap) control signals not less than the safe braking distance in advance of the next signal. Safe braking distances are calculated using a two-second vehicle reaction time, a deceleration rate on level tangent track of 1.95 mph, and a 35 % (distance) safety margin. Track circuits for train protection are shunt-type, phase selective, 60 or 100Hz, with impedance bonds and two-element vane relays. The TriMet ABS system uses multi-aspect signals.

- In addition to track circuits for the detection of train occupancy, signals are controlled by the condition of any track switch in the block or overlap. A red signal is displayed, in the block or overlap, when any of the following conditions occurs:
- A leading train is occupying the track.

- The switch points are not in position for safe train movement.
- A hand-operated switch is not in the fully normal position.
- A switch-and-lock movement is not fully locked.
- Electric switch-locking arrangements are not normal and locked;
- The selector lever of a dual-control switch-and-lock movement is not in "MOTOR" position.

No signal displays an aspect less restrictive than the approach when the next signal in advance displays an aspect requiring a stop.

Three-aspect, non-interlocked signals display a “proceed” aspect when the next signal in advance displays an approach aspect.

Interlockings are provided for the protection of all powered switches. Detector time, route and approach locking is provided. Detector locking remains in effect for a minimum of five seconds after the slow pick up track repeater relays close their front contacts.

The signaling system is bi-directional in the Robertson Tunnel, in areas of single track (e.g. Redline near the Airport), and at the various line terminals (e.g. Expo, Portland Airport). Bi-directional operations on other areas of the line are performed using manual blocks.

A more detailed explanation of the signal system may be found in the Rail Transportation Standard Operating Procedure (SOP) 401, “Automatic Block Signal System (ABS)”.

All interlocking signals and ABS signals, as well as some selected signals in paved track sections, are equipped and enforced with automatic train stops (ATS). The ATS system provides safety assurance by not permitting a train to occupy a segment of track already occupied by another train in ABS territory, not allowing train speed to exceed predetermined safe limits or inappropriate position of a switch.

ATS protection is accomplished through car-borne and wayside ATS equipment. The wayside trip stop is a magnet that is active at all times, unless the signal governing movement over the magnet is displaying a permissive aspect. If a train violates a red aspect, it is automatically tripped by the ATS, placed in an irretrievable maximum brake to zero, forced to wait at rest for 20 seconds, and an on- board counter is indexed. Standard operating procedure is that train operators are to report immediately any trip stop violation to the Operations Command Center. The LRVs include the feature that automatically annunciates a trip stop violation to the Operations Command Center via the 800 MHz radio system

A Train-to-Wayside Communications (TWC) system is used as a primary method of entering route and switch requests. The TWC system consists of a wayside transceiver and an LRV carried transponder. Thumb-wheel switches and push buttons in each LRV cab are provided to train operators to enter the route number and train number and other requests such as switch call and traffic sign preempt call. TWC wayside equipment is provided at all interlockings, at all passenger stations adjacent to highway crossings, and at al power switches in the yard. Crossing gates and flashing signals are used to control grade crossings along the right-of-way in the following segments:

- Eleven-Mile Avenue to Cleveland Avenue (Blue Line)
- SW 114th in Beaverton to SE 12th Avenue, (Blue Line)
- Cascades Station to Portland Airport, (Red Line)
- Main Street station park and ride access road, (Green Line)

- Flavel Street (Green line)
- OMSI to Park Ave, except at segment between SE Pershing to SE Mall (Orange Line)

The operation of the crossing gates and flashing lights is initiated by the presence of a train approaching the grade crossing. In addition to the crossing-gate approach circuits, island circuit are used to ensure that the gates will be lowered and remain lowered when a train occupies that section of track, with in the crossing area. There are a total of thirty-six gated crossings.

In the Burnside Street, Portland Central Business District, Holladay Street and Hillsboro downtown operating areas, a pre-empt traffic signal system is in effect. The system prioritizes train movements through signalized intersections through the train-to-wayside communication system. Upon detection, a signal is sent to the traffic controller to give a clear movement signal to the LRV. All conflicting traffic movements are stopped until the train clears the intersection.

Communication System

The communications system provides a means of exchanging information in real time between the OCC and light rail passenger stations, tunnel sections, Washington Park Operations Room, wayside TES substations, train signals rooms, and communications rooms. This enables the OCC to supervise the entire TriMet light rail system.

Intrusion detection systems have been installed at a few key locations on the light rail system. A zoned summary alarm is sent to the OCC should the system detect an intrusion.

The OCC is also able to monitor station platforms, elevators, and lobbies by means of CCTV cameras. The OCC also has the capability to inform and advise passengers by means of reader boards (text messaging). Transit Tracker signs are capable of displaying “text only” or “text with audio” (the sign automatically speaks any text that is displayed on the sign. Reader boards are being phased out and replaced by the Text and Audio capable Transit Trackers. CCTV and/or Transit Trackers are available at many stations.

Radio transmission is through a 700 MHz radio network. The OCC is linked to the Portland’s 911-control center. The radio system provides a communication link between train operators, rail/road Supervisors, and maintenance personnel.

2. Bus System

Operations

TriMet operates 668 transit buses to handle ridership demands of 198,000 weekday trips throughout the urbanized tri-county area. Eighty-three bus routes serve TriMet customers; most of the lines are routes radiating from downtown Portland. The Portland Mall consists of exclusive lanes for buses on 11 blocks each of Southwest Fifth and Sixth Avenues in the heart of the downtown area. Buses traverse 75,891 service miles on a typical weekday.

The Portland Mall/Central Business District consists of exclusive lanes for buses that extend south on SW Fifth Avenue and north on SW Sixth Avenue in the heart of downtown. Other lines serve as cross-town feeder routes to the light rail system. Bus lines operate 22 hours a day, seven days a week. During peak hours, most routes operate every 5 to 15 minutes. Off-peak, most buses operate on 20 to 30 minute

headways. Mini-buses provide community-based transit service to residential or business loops in Beaverton, Gresham, and Oregon City.

BUS FLEET

The number of buses in TriMet's bus fleet is determined by the projected annual bus schedule requirements with an additional 15% for spares to account for buses in maintenance and inspection or awaiting repairs. All TriMet buses are equipped with fire extinguishers and two-way radios for emergency communications. Buses also have silent alarms for operator/passenger protection. The fleet consists of the following buses:

TriMet Bus Fleet Inventory and Specifications

Fleet/ Length	Units Procured	Units Remaining	Series # From-To	Mfr	Year	Model	Engine	Transmission	Lift/ Ramp	Seating Capacity	Standing Capacity	Width	Length	Height	Wheel Base
#52 - 40'	60	25	2501-2560	NFI	2000	D40LF-SR664	ISC	D863.3T-Dr	Ramp	39	56	102"	480"	110"	293"
#53 - 40'	2	0	2561-2562	NFI	2002	D40LF-SR721	ISL	Allison	Ramp	39	56	102"	480"	110"	293"
#54 - 40'	55	0	2601-2655	NFI	2002	D40LF-SR836	ISL	D864.3E 4-spd	Ramp	39	56	102"	480"	110"	293"
#55 - 40'	25	25	2701-2725	NFI	2003	D40LF-SR882	ISL	D864.3E 4-spd	Ramp	39	56	102"	480"	110"	293"
#56 - 40'	39	39	2801-2839	NFI	2005	D40LF-SR958	ISL/Pegasus	D864.3E 4-spd	Ramp	39	56	102"	480"	110"	293"
#57 - 40'	40	40	2901-2940	NFI	2009	D40LF-SR1301	ISL/Pegasus	D864.5E 4-spd	Ramp	39	56	102"	480"	110"	293"
#58 - 40'	51	51	3001-3051	Gil	2012	G27D102N4	ISL	D864.5E 4-spd	Ramp	39	56	102"	480"	123"	279"
#59 - 40'	4	4	3052-3055	Gil	2012	G30D102N4	ISB	BAE HybriDrive	Ramp	39	56	102"	480"	138"	279"
#59 - 40'	4	4	3056-3059	Gil	2015	G30D102N4	ISB	BAE HybriDrive SUPER	Ramp	39	56	102"	480"	138"	279"
#60 - 40'	70	70	3101-3170	Gil	2013	G27D102N4	ISL	D864.5E 4-spd	Ramp	39	56	102"	480"	123"	279"
#61 - 40'	60	60	3201-3260	Gil	2014	G27D102N4	ISL	D864.5E 4-spd	Ramp	39	56	102"	480"	123"	279"
#61 - 40'	8	8	3261-3268	Gil	2015	G27D102N4	ISL/Pegasus	D864.5E 4-spd	Ramp	39	56	102"	480"	123"	279"
#62 - 40'	30	30	3301-3330	Gil	2014	G27D102N4	ISL/Pegasus	D864.5E 4-spd	Ramp	39	56	102"	480"	123"	279"
#63 - 29'	22	22	3401-3422	Gil	2015	G27E102N2	ISL/Pegasus	D864.5E 4-spd	Ramp	23	40	102"	348"	123"	170"
#64 - 40'	77	77	3501-3577	Gil	2016	G27D102N4	ISL/Pegasus	D864.6E 4-spd	Ramp	39	56	102"	480"	123"	279"
#65 - 40'	50	50	3601-3650	Gil	2016	G27D102N4	ISL/Pegasus	D864.6E 4-spd	Ramp	39	56	102"	480"	123"	279"
#66 - 40'	57	57	3701-3757	Gil	2017	G27D102N4	ISL/Pegasus	D864.6E 4-spd	Ramp	39	56	102"	480"	123"	279"
#67 - 40'	5	5	3801-3805	NFI	2018	Excelsior	Electric	N/A	Ramp	40	56	102"	492"	127"	282"
#68- 40'	64	64	3901-3964	Gil	2018	G27D102N4	ISL/Pegasus	D864.6E 4-spd	Ramp	39	56	102"	480"	123"	279"
#69- 40'	71	71	4001-4071	Gil	2019	G27D102N5	ISL/Pegasus	D864.6E 4-spd	Ramp	39	56	102"	480"	123"	279"

BUS DISPATCH CENTER

The Bus Dispatch Center, part of the OCC, is located in the Operations Headquarters facility and is equipped to maintain radio contact with the active fleet. The Dispatch Center acts on operator requests for maintenance or emergency assistance, and coordinates accident responses by TriMet and local emergency response personnel. The center also coordinates bus service support required because of extended disruption of light rail service.

YARD/MAINTENANCE SHOPS

TriMet maintains three combination yard/maintenance shops:

- Center Street

- Powell
- Merlo Road

These facilities serve as dispatch points for bus service and provide for the cleaning, inspection, and maintenance of buses. Each shop has the facilities, tools and equipment for bus repair and overhaul. The Center Street and Merlo Road facilities have the facilities to repair major damage. Center Street has the additional facilities for engine and transmission rebuilding.

PARATRANSIT SYSTEM

OPERATIONS

TriMet operates a fleet of 254 lift-equipped mini-buses and 15 sedans used to deliver LIFT service. LIFT provides approximately 3800 weekday rides, 1400 rides on Saturday and 1300 rides on Sundays and Holidays. Lift provides service between 4:30am and 2:30 am, seven days per week, 365 days per year.

The LIFT fleet buses are equipped with Ricon, Braun or Maxon lifts, are 25 feet in length, and have a life cycle of 10 years. It is TriMet's goal to maintain a minimum 15% spare ratio for the overall LIFT fleet.

LIFT DISPATCH CENTER

The TriMet LIFT Program operations include a central dispatch center, a central maintenance garage and three transportation centers. LIFT Central Dispatch, located at the NELA facility in NW Portland receives ride requests, schedules and dispatches rides; and responds to customer contacts. LIFT Central Maintenance also located at the NELA facility performs all vehicle maintenance, excluding those minor maintenance activities specifically outlined as the responsibility of the LIFT Transportation. Two additional transportation facilities are located in SE Portland and Beaverton.

TRANSIT CENTERS, PARK & RIDES, AND PARKING GARAGES

TriMet maintains 18 transit centers, 70 park and ride lots, and approximately 900 bus shelters. The transit centers are located in important hub locations for multiple bus lines or multiple bus lines and light rail stations. Forty-three (43) of the Park and Ride lots are shared-use facilities; often, church parking lots are made available to transit users during the workweek. TriMet owns and maintains an additional 27 Park and Ride lots. Additionally, TriMet owns and operates three multi-level parking garages.

The Gresham Garage is a 4-story park & ride facility with approximately 500+ parking spaces. The building is of Type-II, 1-hour construction with a Class I dry standpipe system. The Sunset Transit Center Parking Garage is a 3-story park & ride facility with approximately 595 parking spaces. The building is of Type-II, 1-hour construction with a Class I dry standpipe system. Attached to the upper level of the garage is a pedestrian over-crossing structure spanning US Highway 26, providing access to the Sunset Transit Center for foot traffic. The Gateway Transit Center garage is a 4-story park & ride facility with approximately 400+ parking spaces. The Clackamas Transit Center garage is a 4-story park& ride facility with approximately 700 parking spaces.

INTERFACE WITH PORTLAND STREETCAR

Portland Streetcar is managed and Operated by the City of Portland, and is supported by TriMet. TriMet supplies Rail Operators, Supervisors and Rail Maintenance Staff. In addition, TriMet maintains the trackway and OCS.

MAX and Streetcar tracks intersect in eight locations: 5th and Market, 5th and Montgomery, 6th and Mill, 6th and Market, 10th and Morrison, 10th and Yamhill, 11th and Morrison and 11th and Yamhill. All eight locations are signalized.