Connecticut Department
Of Transportation

CTfastrak Project
State Project No. 171-305

Safety and Security
Management Plan
Fourth Edition

September 9, 2013
Safety and Security Management Plan Approval

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Revision Record

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List of Acronyms

ANSI  American National Standards Institute
APTA  American Public Transportation Association
BMO  BRT Maintenance Organization
BOC  Bus Operations Center
BOCA  Building Officials & Code Administration International
BRT  Bus Rapid Transit
CCTV  Closed Circuit Television
CE&I  Construction Engineering and Inspection
CFR  Code of Federal Regulation
CHEMTRE C Chemical Transportation Emergency Center
CPTED  Crime Prevention Through Environmental Design
CSSP  Construction Safety and Security Plan
CTDOT  Connecticut Department of Transportation
DCCC  Design Criteria Conformance Checklist
DHS  Department of Homeland Security
ECN  Engineering Change Notice
EMP  Emergency Management Plan
EMS  Emergency Management System
EOP  Emergency Operating Procedures
FLSC  Fire/Life Safety Committee
FMEA  Failure Mode and Effect Analysis
FRA  Federal Railroad Administration
FTA  Fault Tree Analysis
FTA  Federal Transit Administration
HRI  Hazard Risk Index
HVAC  Heating, Ventilation and Air Conditioning
IFB  Invitation for Bid
MCS  Manager, Construction Services - Baker
MIL-STD  Military Standard
MUT  Multi-Use Trail
NEC  National Electric Code
NFPA  National Fire Protection Association
NTI  National Transit Institute
NTSB  National Transportation Safety Board
MUTCD  Manual on Uniform Traffic Control Devices
MUT  Multi Use Trail
OSHA  Occupational Safety and Health Administration
O&SHA  Operations and Support Hazard Analysis
PCN  Proposed Change Notice
PHA  Preliminary Hazard Analysis
PHVA  Preliminary Hazard and Vulnerability Analysis
PM  Program Manager - Baker
PMC  CTDOT Project Manager, Construction
PMD  CTDOT Project Managers, Design
Introduction

The Federal Transit Administration (FTA) requires grantees undertaking major capital projects to prepare a Project Management Plan (PMP). Section 5327 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), signed into law on August 10, 2005, now requires that a Safety and Security Management Plan (SSMP) must be referenced or included as part of the Project Management Plan (PMP). This new regulation codifies into Federal law practice previously contained in FTA’s Full Funding Grant Agreement (FFGA) Circular 5200.1A, Chapter II, Section 6, issued on December 5, 2002. Additional requirements and guidance for SSMPs are provided by FTA in Circular 5800.1 (Safety and Security Management Guidance for Major Capital Projects, August 1, 2007) and Safety and Security Management in Rail Transit Projects, June 2007.

The Fourth Edition of the “New Britain-Hartford Busway Project Management Plan” was issued in November 2012. This SSMP was revised to be consistent with the updated PMP and to conform to the current status of the Project’s development. The initial SSMP, dated August 4, 2006, was updated as the Second Edition on November 20, 2009 to incorporate updated FTA guidance. It was most recently updated on June 4, 2012 as the Third Edition, which was used as the baseline for this version, the Fourth Edition. Modifications to the SSMP are performed in response to comments received from the FTA’s Project Management Oversight Consultant (PMOC), whenever the PMP is revised, and as required during the life of the project.
Apart from meeting FTA requirements, the SSMP aids the management team in identifying the tasks necessary for a successful project, and the people, methods, resources, and lines of communication needed to carry out those tasks. It also communicates to all project participants the project’s purpose and the roles, responsibilities and authorities assigned to each member of the project team.

The CTfastrak Project is committed to maintaining the SSMP and ensuring that it is updated to reflect significant changes in the project organization, administrative policies and procedures, contracting conditions, budget and schedule, and other significant matters affecting management of the project.

A companion document to the SSMP is the Safety and Security Certification Plan (SSCP), which was published on February 26, 2009. It is currently being updated to achieve compatibility with the PMP and SSMP.

Note that until June 2013, the PM Team included a Safety and Security Consultant with well-defined responsibilities and authority for leading safety and security activities and developing documentation. In June 2013, with the CTfastrak Project in the construction phase and approaching the operational readiness phase, and with safety and security processes firmly established, the approach to safety and security management has been modified. Following the previously established safety and security plans and processes, other PM Team Members will have greater responsibility for implementing the safety and security program using existing staff and the guidance and services of Transportation Resource Associates, Inc. (TRA), a transit safety and security consultant experienced in meeting FTA major transit project safety and security requirements related to operational readiness and certification. As part of this transition process, the SSCRC’s mission and composition has been reevaluated and appropriate changes made.
1 Management Commitment and Philosophy

The Safety and Security Management Plan (SSMP) has been developed and is administered by the CTfastrak Project (previously referred to as the New Britain-Hartford Busway Project) as a proactive element of the project’s System Safety and Security Program. The SSMP defines the safety and security requirements applicable to the project and how these requirements are achieved. The SSMP defines the safety and security of project personnel, including contractor and consultant personnel. It further defines the system safety and security organization including safety and security related committees and consultant/contractor support staff, and requirements for training, site safety and security, accident/incident reporting and investigation, Contractor compliance, and enforcement of all other system safety and security requirements. The SSMP functions as the primary mechanism through which internal and external system safety, security, and regulatory requirements are achieved throughout the life-cycle of the project.

1.1 System Safety and Security Policy Statement

The CTfastrak Project has been developed with the mission and objective to provide safe, secure, reliable and effective transportation services to all users, while minimizing vandalism and property destruction associated with vehicles, facilities, and systems. System Safety and Security is a primary concern that affects all levels of project activities including planning, design, construction, procurement, testing, training, operations and maintenance.

Therefore, all project personnel are charged with the responsibility of promoting the safety and security of passengers, employees, and the general public who come in contact with the CTfastrak Project during each project phase. The safety and security of our customers and our employees are our greatest responsibility. All employees and contractors of the CTfastrak Project are expected to conduct their duties in a safe manner that will prevent and minimize injuries and property damage, throughout each project phase. All employees and contractors are also required to bring any conditions perceived to affect security to the attention of project management. Each employee must operate safely; use equipment, tools and materials properly, and be totally familiar with work rules and procedures for their areas of responsibility. Each employee shall take an active role in the identification and reporting of hazards and potential system threats and vulnerabilities. Supervisors shall actively participate in the assessment and resolution of hazards, threats, and vulnerabilities, and shall fully cooperate with project safety staff.

CTfastrak Project management provides leadership in promoting safety and security throughout the organization. Executive staff is fully responsible for safety policy, goals, and objectives. Project management provides the authority, support and resources to establish and maintain high safety and security standards for the project. Connecticut Department of Transportation (CTDOT) staff and contractor employees shall comply
with the provisions of the SSMP and shall fully cooperate with the safety staff in achieving CTfastrak Project’s safety and security goals and objectives.

1.2 Purpose of SSMP

The purpose of the CTfastrak SSMP is to provide guidelines and a process to facilitate the application of system safety and security concepts and requirements to aid in the management of project risk; providing a formal structure, which supports the forward-looking identification and control of system hazards, and potential threats and vulnerabilities.

1.3 Scope of SSMP

This SSMP applies to all project development activities through preliminary engineering, final design, construction, integrated testing, demonstration, and operations. The scope encompasses the following:

- System-wide Elements – includes voice and data communications, CCTV, grade crossing and traffic control systems, intrusion detection systems, fare collection, supervisory and data acquisition control systems, fire protection and suppression systems, and auxiliary vehicles and equipment.

- Fixed Facilities - includes stations and shelter stops, and parking facilities. Equipment installed in these fixed facilities, such as HVAC, lighting, plumbing is considered part of the facility.

- Safety, Security, System Assurance, Operational, and Maintenance Plans and Procedures - which may include items such as System Safety and System Security Program Plans, Emergency Response Plans, training programs, operating rules and procedures, emergency operating rules and procedures and system activation plans.

- The SSMP documents technical and management strategies for the identification, assessment, prevention, and control of safety hazards and security threats and vulnerabilities during each project phase from planning to initiation of operations. Accordingly, the SSMP, in conjunction with the SSCP, previously referred to as the SSC Program Plan, SSCPP), provides critical support for the successful initiation of the project into revenue operations.

The SSMP promotes continual improvement in safety and security, guiding the CTfastrak Project’s efforts to ensure that:

- in each project phase, safety hazards and security threats and vulnerabilities will be identified and assessed, and documented action will be taken to resolve and track them;
appropriate codes, guidelines, and standards have been reviewed to provide a basis for safety and security considerations in the project design criteria and specifications, and project drawings and specifications are in conformance with the adopted design criteria;
facilities, systems, vehicles, and equipment are constructed, procured, installed, inspected and tested in accordance with adopted safety and security requirements, design criteria and manuals;
necessary verification tests, safety and security plans, operating procedures and manuals, training, and rulebooks are developed prior to revenue operations; and
personnel are trained and qualified to operate and maintain the system and respond to emergencies, and emergency response organizations are familiar with the project’s revenue operation and emergency procedures.

1.4 SSMP Goals

CTfastrak Project management’s primary goal in implementing this SSMP is to ensure that the final project placed into revenue service is safe and secure for passengers, employees, public safety personnel, and the public. Secondary goals that further support the primary goal are to provide:

- clear determinations regarding acceptable safety and security risks, articulated in policy by the project’s executive management team;
- verification that an acceptable level of safety and security is designed into the transit project;
- consistent evaluation of safety and security risk throughout the project development process; and
- consistent application of safety and security verification activities to support initiation of the project into revenue service.

1.5 SSMP Objectives

The objectives established to meet the goals of the SSMP include:

- establish criteria for acceptable levels of risk, signed-off by the SSCRC Chairperson, to guide the review and evaluation of safety and security issues throughout the project;
- provide mechanisms for the formal identification, consideration, elimination or control of hazards and vulnerabilities to passengers, employees, contractors, emergency responders, and the general public;
- verify that appropriate codes, guidelines and standards have been reviewed to provide a basis for safety and security considerations in the design criteria and that design criteria conformance checklists have been developed and implemented to document this review;
verify that appropriate specifications and drawings are in conformance with the design criteria and that design conformance checklists have been appropriately developed, completed, and certified;

verify that contract deliverables (facilities, systems and equipment) are reviewed against the contract specifications and drawings (including all engineering changes) for compliance with safety and security requirements, using checklists to document construction specification conformance;

validate the necessary tests and safety plans, safety-related operating and maintenance procedures and training, and the rule book to ensure safety and security for operational service;

verify the emergency preparedness and operational readiness of the project initiated into revenue service;

ensure that safety and security requirements are addressed in each phase of the project through the enactment of policies and the use of procedures that promote system safety and security;

ensure safety and security considerations are addressed and adequately evaluated and resolved throughout all project phases;

maintain a level of project safety and security that meets or exceeds regulatory requirements, and levels experienced by similar U.S. bus rapid transit operations;

ensure all contract agreements and specifications, including standard specifications and procurement documents, include specific language requiring contractor compliance with all project, state, Federal, and local safety and security requirements;

ensure that the Contractor implements the required procedures, plans, practices and processes to achieve compliance with the requirements of the System Safety and Security Program and other state, federal, and local regulations through audits and other reviews of contractor procedures, plans, practices and processes;

heighten safety and security awareness among all project participants; and enable project personnel to identify, eliminate, minimize, and/or control hazards, threats and vulnerabilities, and their associated risks prior to their resulting in a loss (i.e., injury, illness, death, system loss, property damage, or property loss);

require that all proposed designs incorporate and consider system safety and security features as an integral part of designs from the Preliminary Engineering to the Final Design phases of the project;
include in contract documents and specifications, minimum requirements regarding safety and security, such as those pertaining to experience and qualifications, regulatory requirements, training, accident/incident identification and prevention, emergency preparedness and response, and safety and security program enforcement which must be met by contractors of the project;

- require all applicable employees and contractors undergo appropriate safety and security training and establish a monitoring program to verify and document contractor activities for compliance with accepted and required safety and security practices;

- require, during the design, construction, testing, and pre-revenue operational phases, employees, consultant and/or contractor staff undergo appropriate transit safety and security training, as well as job-specific and/or site-specific safety training;

- assign responsibilities related to system safety and security policies, procedures, and requirements and establish a monitoring program to verify and document compliance with these requirements;

- require contractors to thoroughly investigate all accidents/incidents including fires, injuries and near misses to determine root causes;

- thoroughly evaluate the system safety and security implications of all proposed system modifications, prior to implementation, to ensure new hazards will not be created;

- minimize system modifications during the pre-revenue operational stage by establishing and utilizing safety and security controls from system design to the procurement and construction stages; and

- thoroughly evaluate and verify the operational readiness of the system, prior to the start of revenue operations.
2 Integration of Safety and Security into Project Development

CTDOT is responsible for all transportation programs and projects for Connecticut involving highways, airports, ferries, port operations, highway safety and public transit including Bus Rapid Transit (BRT) facilities. As such, CTDOT is responsible for the management, design, construction and acceptance of the CTfastrak Project. After CTDOT accepts the construction, it will take ownership and assume responsibility for start-up, operations, safety, security and maintenance of the completed CTfastrak Project.

2.1 Safety and Security Matrix

This matrix (on the following page) identifies all safety and security activities that have been, or will be, performed for the project during preliminary engineering, final design, construction, integrated testing, demonstration and operations.

2.2 Procedures and Resources

The SSMP has been drafted to expand on and augment the safety and security requirements of the PMP. It explains how the safety and security discipline is integrated into the project design, construction, training, testing, verification and revenue service. The SSCP has been developed as a separate document to describe the SSC program and tasks to be performed to achieve final SSC of the completed project. The SSC process assists in identifying and eliminating hazards throughout all project phases.

2.2.1 Organizational Strategy

CTDOT's organizational strategy for the CTfastrak Project with regard to project development and implementation includes:

- Utilization of in-house staff to prepare grant related documentation; to oversee the program; to independently review and approve deliverables during design; to administrate, survey, measure, and inspect construction or oversee construction engineering and inspection by a consultant;
Figure 2-1: Safety and Security Activities Matrix

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<tr>
<td>Develop Safety and Security Policy Statement</td>
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<td>Establish Responsibilities for Safety and Security throughout the Project</td>
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<td>Develop Safety and Security Management Plan</td>
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<td>Establish Safety and Security Committees</td>
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<td>Create Safety and Security Responsibilities Matrix</td>
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<tr>
<td>Develop Safety and Security Certification Plan</td>
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<tr>
<td>Develop and Implement Hazard and Vulnerability Resolution and Tracking System</td>
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<td>Prepare Preliminary Hazard and Vulnerability List</td>
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<td>Identify Safety and Security Certifiable Elements</td>
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<td>Establish Safety and Security Certifiable Items List</td>
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<td>Establish Safety and Security Configuration Management</td>
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<td>Create Safety and Security Certification Project Folders</td>
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<tr>
<td>Perform Preliminary Hazard Analysis and Threat and Vulnerability Analysis</td>
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<td>Prepare Safety and Security Design Criteria</td>
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<td>Perform Safety and Security Review of Preliminary Operations and Maintenance Procedures</td>
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<td>Perform Safety and Security Design Reviews &amp; Additional Hazard and Vulnerability Analysis</td>
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<td>Develop Design Criteria Conformance Checklists</td>
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<td>Complete Design Criteria Conformance Checklists</td>
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<td>Develop Test and Evaluation Requirements</td>
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<tr>
<td>Develop Specification Conformance Checklists</td>
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<tr>
<td>Complete Specification Conformance Checklists</td>
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<tr>
<td>Issue Notices and Occupancy Permits</td>
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<td>Issue Certificates &amp; Complete Folders</td>
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<tr>
<td>Complete Integrated Tests</td>
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<td>Review of Engineering Change Orders &amp; Waivers</td>
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<td>Perform Final Safety and Security Compliance Assessment</td>
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<td>Issue Final Safety and Security Certification</td>
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<td>Issue Final Safety and Security Verification Report</td>
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MGT = Management
ENG = Engineering
PE = Preliminary Engineering
FD = Final Design
CON = Construction
IN TST = Integrated Testing
DEM = Demonstration
OPS = Operations

Checks (✓) indicate the initiation of the activity, and shaded arrows (➔) indicate on-going performance.
delegation of responsibility to a Program Management (PM) consultant for preliminary and select final engineering design, program scope, schedule and cost reporting; project safety and security assurance including the certification process and oversight of construction safety and security; independent review and comments on deliverables from Final Designers; and subcontracted construction management services;

- delegation of responsibility to Final Designers for Final Design, and contract progress, schedule and budget reports;
- utilization of contractors for construction and contract schedules;
- utilization of in-house and PM staff to develop policies for bus operations, safety and security, roadway and station maintenance;
- utilization of in-house staff to procure BRT fleet; and
- utilization of public transit providers to provide bus operations under contract to CTDOT.

2.2.2 Program Management Approach

The CTfastrak program management approach features a nucleus of experienced transportation and transit professionals and relies on a program management consultant (PM) – Baker – to augment and support the CTDOT workforce. The PM will support CTDOT staff in program management functions necessary to maintain, monitor and verify the project schedule and budget. The advantages of this approach are reduced overhead, minimization of staffing-up time, maximization of flexibility in regulating the workforce and elimination of any staff reduction process at the end of the project. The project management approach will include the following:

- Organization, mobilization and direction of the work
- Execution of design, procurement and construction
- Project controls, including cost control, change control, scheduling, materials control, and quality control
- Coordination and management of the work of consultants and contractors
- Administration and project procedures
- Quality
- Safety and Security
- Program and Project Management
- Administrative and technical support

The objective of this approach is to provide assurances that risk management, safety and security analysis, and corresponding verification requirements will be applied to the CTfastrak project, and that the results will be tracked through to acceptance or resolution throughout the project life cycle.
2.2.3 Safety and Security Related Procedures and Instructions

Written procedures and instructions have been developed for activities affecting safety and security in design, procurement, manufacturing, and construction as applicable to the work performed. Procedures and instructions have been developed to guide the preparation and management of critical safety and security documents and activities, as depicted in the Safety and Security Activities Matrix (Figure 2-1).

These procedures contain a statement of the purpose and scope, and any references to appropriate codes, standards, or specifications. In developing these procedures, consideration has been given to identifying and acquiring any special equipment, skills, or capabilities needed to ensure their performance. The procedures and instructions also contain formats for the records needed to ensure that the procedures and instructions are followed and documentation requirements are understood.

Key CTDOT and CTfastrak policies, procedures and instructions that have safety and security implications are described in detail in Section 1.2.1 of the CTfastrak Quality Management Plan.

2.2.4 Configuration Management for the Control and Dissemination of Documents and Records

Procedures for the control and dissemination of CTfastrak Project documents and records are included in: the CTfastrak Quality Management Plan in Section 1.2.3, Control of Documents and Section 1.2.4, Control of Records, and in the Document Management Plan, Appendix A of the PMP.

A Configuration Management Plan is included as Appendix B of the PMP. The Configuration Management Plan for the CTfastrak Project includes procedures to define, evaluate, identify, control and record the baseline attributes, budget, schedule, performance, and function. It accentuates the technical coordination processes for the successful interface and functionality of disparate systems and designers. It serves as an aid to maintaining consistency between the CTfastrak's performance, functional and physical attributes and its requirements as to design and operations. The Configuration Management Plan enhances and reinforces technical coordination by defining the project baseline and controlling changes to this baseline as design and construction progress.

The Configuration Management Plan identifies the baseline documentation, establishes configuration items and related baseline conditions, summarizes the formal configuration change controls, introduces configuration status accounting via records and status tracking, and describes audit process for baseline documents (e.g.,
deliverables) that define the project baseline.

2.2.5 Resources Allocated to Address Safety and Security Activities

The CTfastrak Project management team will ensure that:

- all identified safety and security tasks will be performed throughout the project by construction contractors and consultants;
- designated project and construction contractor personnel are assigned responsibility for safety and security;
- resources are assigned for the performance of specified safety and security activities; and
- policies and procedures that require management review and evaluation of safety and security activities are developed.

2.3 Interface with Management

Responsibility for administration of the CTfastrak Project through all of its phases rests with the CTDOT CTfastrak Program Director who reports directly to the CTfastrak Program Administrator with oversight from CTDOT Executive Managers. Accordingly, the Program Director will be the "person in charge" at any given stage of the Project. CTDOT Executive Managers include the Commissioner, Deputy Commissioner, Chief Engineer and Construction Bureau Chief. CTfastrak organization charts are depicted in the PMP.

Key CTDOT, CTfastrak and construction contractor personnel and participants have been assigned roles and responsibilities for implementing safety and security requirements, programs and activities. This facilitates the integration of safety and security into the design, construction, testing, and operation phases of the CTfastrak Project. It also allows for better alignment and coordination of safety and security activities with project engineering, quality assurance, control activities, and programs. The following provides a summary of the roles and responsibilities of key CTfastrak Project personnel:

2.3.1 Program Director

The Program Director continues to manage and direct the design development and construction of the CTfastrak Project. The Program Director's primary role on the project is to provide general project oversight and to support the entire CTfastrak Project organization. This role focuses on issues regarding planning, programming, budgeting, implementation, and conferring with the FTA and other governmental
agencies on sensitive matters. The Program Director attends the monthly program meetings with the CTDOT Project Managers, chairs the quarterly executive briefings with CTDOT management, and attends the FTA/PMOC quarterly review meetings. The Program Director also provides continuity on the project among CTDOT offices both on technical matters and contract administration.

The Program Director continues to design, implement, and administer a comprehensive, integrated, and coordinated system safety and security program for the CTfastrak Project. The foundation for this program is established by this SSMP. The Program Director holds ultimate responsibility for the SSC process of the project including the design, and construction of the system. This also includes providing final SSC that the completed project is safe and secure for operation. Note: Construction contractors are ultimately responsible for maintaining a safe and secure workplace for their personnel and CTfastrak Project personnel and consultants who work on project sites.

Where it has been determined that an immediate and serious hazard exists, the Program Director has the authority and responsibility to order hazardous conditions corrected or hazardous practices halted. Accordingly, the Program Director is empowered to order the cessation of all unsafe activities or operations that have been determined to be an immediate and serious hazard. The Program Director will submit recommendations received from the Project Managers and the SSCRC for hazards, categorized as unacceptable risks, to the CTDOT Executive Managers for appropriate action.

2.3.2 Project Managers

The responsibilities for project management are divided into three positions: one Project Manager, Design and two Project Managers, Construction.

2.3.2.1 Project Manager, Design

The Project Manager, Design (PMD) have CTDOT responsibility for design project performance and implementation including:

- Design implementation activities, ensuring timely communication of project status and issues, and maintaining controls for the work.
- Oversee, guide, and direct operations of CTDOT personnel and the design consultants.
- Ensure that the CTfastrak design effort is completed on time, within the approved budget, and in accordance with the design criteria, contract documents, and CTDOT procedures.
Oversee and coordinate design activities required to complete all aspects of the CTfastrak project, manage daily activities of the CTfastrak design team, and coordinate work of functional and support staff across organizational boundaries.

Monitor the master schedule for the project, the preparation of conceptual, preliminary, and final engineer's cost estimates, and the forecast of final project costs, and participates in the preparation of schedules, capital budgets, and annual design work programs.

Directing and monitoring the cost estimating and detail scheduling of the physical effort required to accomplish all phases of the CTfastrak.

In conjunction with the Project Manager, Construction, coordinate with the law department, administrator of rights of way (real estate), and administrator of engineering on agreements with private property owners, franchised utilities, railroads, and governmental entities.

Oversee, coordinate, and implement the Stations Design Program.

Monitor and validate implementation and recordation of CTfastrak quality policies and procedures.

2.3.2.2 Project Manager, Construction:

The Project Manager, Construction (PMC) has overall CTDOT responsibility for project performance, implementation, and construction including:

- Managing project implementation activities, ensuring timely communication of project status and issues, and maintaining controls for the work.
- Oversees, guides, and directs operations of CTDOT construction project personnel.
- Performs planning, coordination, and administration of the activities of the Construction Unit in the Districts and the Construction Unit in the main office.
- Coordinates with: the PMD; the CTDOT Transportation Construction Administrator; and the CTDOT Assistant District Engineer to ensure that the CTfastrak is completed on time, within the approved budget, and in accordance with the design criteria, contract documents, and CTDOT procedures.
- Oversees and coordinates construction activities required to complete all aspects of the CTfastrak Project, manages daily activities of the CTfastrak team, and coordinates work of functional and support staff across organizational boundaries.
- Monitors the master schedule for the project and the forecast of final project costs, and participates in the preparation of schedules, capital budgets, and annual work programs.
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Directs and monitors the cost estimating and detail scheduling of the physical effort required to accomplish all construction phases of the CTfastrak.

In conjunction with PMD coordinates with the administrator of rights of way (real estate), and administrator of engineering on agreements with private property owners, franchised utilities, railroads, and governmental entities.

Monitors and validates implementation and recordation of CTfastrak quality policies and procedures.

2.3.2.3 Safety and Security Management

The Program Director accomplishes safety and security management responsibilities collectively through the SSCRC and/or through the individual members of the SSCRC, supplemented by the PM Safety and Security Team (PMSST), which consists of assigned personnel from among the following Baker and TRA senior staff supplemented by appropriate support staff:

- Mark Witek – Overall Baker S&S coordination
- Greg Lassiter – Baker S&S coordination for design
- Pete Maiorana – Baker S&S coordinator for construction
- Graham Carey – Baker S&S coordinator for operational readiness
- Tom Luglio – TRA safety specialist
- Jimmy Hill – TRA security specialist

The SSCRC is responsible for reviewing safety and security analyses, development of safety and security standards, the safety and security verification process, and ensuring CTDOT staff, consultants and contractors adhere to the standards. Additionally, the SSCRC is responsible for implementation of the SSMP, the SSCP and related safety and security documents to ensure the system is safe and secure for public use prior to the start of revenue service. The SSCRC has defined the system SSC Program requirements and ensured the planning, implementation, and accomplishment of system SSC tasks and activities consistent with the overall program requirements. The SSCRC serves in the capacity outlined in the SSMP and the SSCP to conduct meetings to ensure compliance through final design, construction, testing and operational readiness of the CTfastrak Project. The SSCRC, with the support of the PMSST, will certify all aspects of CTfastrak Project safety and security as required by the FTA.

The Program Director, through the Baker Project Manager, Construction Services (PMCS), has developed construction safety and security requirements as described in Section 8 of this document. They require construction contractors to develop safety, health and security plans for their employees and ensure compliance with the safety and security requirements and regulations.
Construction contractors and subcontractors (supervision and management) are responsible for the daily oversight, identification, and control of operating and workplace hazards to ensure the highest degree of safety for contractor employees, on-site CTfastrak personnel, site property (as well as property of the communities in which CTDOT provides service), and the public. Where it has been determined that an immediate and serious hazard exists, the Program Director or designee, has the authority and responsibility to order hazardous conditions corrected or hazardous practices halted. Accordingly, the Program Director or designee, in consultation with the PMC, is empowered to order the cessation of all unsafe project activities or operations that have been determined to be an immediate and serious hazard. The Program Director is also empowered to direct that unannounced audits be conducted aimed at identifying and eliminating unsafe practices, operations, and conditions not immediately corrected by construction contractors’ management or supervision. The PMC will, as necessary, request that the Resident Engineer monitor construction site safety and security as part of the construction engineering and inspection duties (per Section 12.2.3 of the PMP). Chief Inspectors and Inspectors also monitor site safety and security in accordance with Section 1-107 of the CTDOT Construction Manual as supplemented by the requirements of the CTfastrak Project.

The Program Director ensures that the safety and security activities are coordinated with the following project elements via the SSCRC and the PMSST by assigning specific safety and security tasks to designated project management staff:

- **Project Management Plan** – to ensure that safety and security activities are among the key activities identified for the project, Chapter 15 includes specific safety and security requirements. Chapter 2 of the PMP assigns responsibility for safety and security responsibilities to project management staff. The PMP includes provisions to ensure that required safety and security requirements of the following project elements are implemented:

  - **Project Solicitations** (Request for Proposal [RFP], Invitation for Bid [IFB], other procurement vehicle) – to identify activities to be performed by the project contractors to ensure that safety and security are designed into the system and delivered in the project received by the agency. PMP Chapter 7.0.

  - **Project Evaluation and Award Process** – to assess the quality of contractors’ responses to the safety and security activities identified in the Solicitation and to request additional activities (if necessary) during negotiation of final contract. PMP Chapter 7.0.

  - **Project Contracts** – to provide legal and administrative documentation of the safety and security activities to be performed by the contractor. PMP Section 15.3.
Quality Control/Quality Assurance Program – to ensure that activities performed for the project’s quality management system incorporate safety and security requirements and that the results, in each project phase, are accessible to the designated safety and security functions. PMP Section 3.9.

Engineering and Inspection Services – to perform safety and security analysis, to perform or witness specific tests, and to provide technical expertise in specific project areas (software safety, electrification). PMP Section 12.9.

Design Criteria Manuals – to ensure that safety and security requirements are clearly identified in the manuals and other references used to develop the preliminary and final designs and to prepare specifications. PMP Chapter 9.0 and Connecticut Busway Design Manual Section 5.5, Safety and Security Measures.

Project Milestone Schedule, including Design Reviews – to ensure that requirements to address safety and security are tied to project advancement and contractor payment. PMP Sections 1.5, 9.5 and 12.4.

Project Testing Program Plan (TPP) – to ensure performance of all tests necessary to verify that the delivered project complies with approved project specifications and that appropriate supporting verification documentation is filed with the safety and security certification program. PMP Section 12.8.

Operational Readiness Reviews – to ensure that safety and security are addressed in operating and maintenance manuals and rules, standard and emergency operating procedures, training, equivalencies and other activities developed to address change orders and deviations from the approved design during construction. PMP Section 16.3.

Auditing Services – to ensure that contractors and others are following criteria, safety and security testing and acceptance standards, and safety and security management practices. Construction safety and security audits are conducted as described in Section 8.10.

Figure 2-2 provides an illustration of the activities to be performed to effectively integrate safety and security into the project development process. At each stage in this process, those personnel designated to manage or oversee safety and security activities have access to and support from the Program Director. Other critical partnerships have been established with procurement, project engineering, inspection
and auditing functions, the operations and maintenance group, and the quality control/quality assurance program.
Figure 2-2: Integration of Safety and Security into Project Development Process
3 Authority and Assignment of Safety and Security Responsibilities

3.1 Safety and Security Authority for the CTfastrak Project

- Initiating authority for safety and security rests with the CTDOT Executive Managers and the CTfastrak Program Administrator.

- Implementing authority is delegated to the Program Director.

- Day-to-day safety and security certification authority rests with the PMSST and the SSCRC. The Program Director oversees safety and security activities throughout all phases of the Project.

- Advisory authority rests with the SSCRC, the Fire/Life Safety Committee (FLSC), and any designated subcommittees or working groups. These organizations contribute to the safety and security throughout the project development process. Eventually, as the project initiates revenue service, safety and security responsibilities will transition to the operational system.

- Configuration Authority for the safety and security elements of the project is provided in Section 3.11 of the PMP. Initiation of Changes/Preparation of Project Change Notice (PCN) documentation is managed by the PM, PMCS and PMC. Depending on cost, the PCN is submitted to the CTDOT Program Task Force. Accepted changes that are greater than $250,000 or Program Critical must be reviewed by the CTDOT Construction Administrator or the Chief of the Bureau of Engineering and Highway Operations Commissioner. The PMSST, PMCS and PMC ensure that the final Safety and Security Design Verification and Construction Specification Conformance Checklists reflect the correct versions of specifications, drawings and bid package materials.

- Readiness Assessment Authority rests with CTDOT staff and the Operations Plan Committee and its Subcommittees. Safety and security elements will be assessed by the PMSST and affirmed by the SSCRC. They will oversee the development and implementation of the safety and security aspects of rules, procedures, plans, programs, and integrated and acceptance tests, pre-revenue demonstrations, and certification programs for operations and maintenance personnel.

- Certification Authority for the CTfastrak Project rests with the CTDOT CTfastrak Program Director with support from the SSCRC and the PMSST. The Program Director must receive and accept the safety and security certification that the project to be initiated into revenue service is safe and secure.
3.2 Safety and Security Organizational Responsibilities for the CTfastrak Project

Organizational responsibilities, including those for safety and security, are described in the PMP. The Program Director, the PMSST, the PMCS, the PMC, the District 4 Construction Office, the Construction Engineering & Inspection (CE&I) staffs, and each contractor, have responsibility for coordination of the CTfastrak Safety and Security Program. The PMSST supports the SSCRC in the review of project-specific safety and security issues.

The engineering and project management teams have worked with the PMSST to implement safety and security activities, and have been responsible for the incorporation of system safety and security requirements in the design and construction of the CTfastrak Project. External resources such as Federal, State, and Local law enforcement agencies, Bus Operations personnel, the SSCRC, FLSC and their individual members, and the Department’s Office of Public Transportation have been utilized in the development and oversight of safety and security plans. System safety and security tasks have included review of all designs for safety components and elements, hazard analysis, safety and security certification, threat and vulnerability assessment, railroad safety issues, bus operational concerns, and special studies related to specific safety and security issues. The Program Director and members of the PMSST coordinate these functions for the project.

The engineering and project management teams are responsible for project execution and construction management. This includes responsibility for overseeing the contractors’ construction safety and security activities. The PMSST, in cooperation with the PMC, oversees safety and security activities for the CTfastrak Project; however, contractors are ultimately responsible for accident prevention and job site safety and security and compliance with regulations.

3.2.1 Safety and Security Responsibilities

Until June 2013, the PM Team included a Safety and Security Consultant with well-defined responsibilities and authority for leading safety and security activities and developing documentation. In June 2013, with the CTfastrak Project in the construction phase and approaching the operational readiness phase, and with safety and security processes firmly established, the approach to safety and security management has been modified. Following the previously established safety and security plans and processes, the recently established PMSST, guided by the SSCRC, has greater responsibility for implementing the safety and security program using existing staff and specialty consulting services. The PMSST has the following responsibilities for safety and security:
Advises the Program Director regarding safety requirements, hazard analysis, and the overall safety or security status of the project.

Coordinates the system safety and security certification effort with systems engineering, civil structures, reliability and quality assurance, integration and testing, and program management functions.

Identifies necessary technical safety criteria and requirements (including those associated with interfacing hardware, software, and facilities) and ensures their incorporation into designs, specifications and planning documents.

Ensures that submitted Hazard Reports contain sufficient information to permit the Program Director to make informed decisions.

Reviews system safety tasks, prioritizes safety risks, and recommends engineering, procedural, or other changes necessary to reduce the risk to an acceptable level.

Ensures the implementation of a closed-loop process for providing traceability and tracking of all hazards from identification through resolution.

Assists the Program Director in coordinating with the committees assigned safety and security issues and with external agencies.

Participates in all major design reviews, and provides the following:

- Lists of preliminary hazards and other safety/security concerns
- Completed hazard analyses appropriate to the level of design detail
- Recommendations for corrective actions and controls, based on analysis and sound engineering and management principles
- Reports documenting on-going safety and security certification activities and concerns

Participates in all major activities to review and accept the delivered project, system, sub-system or component, and provides a safety and security assessment and a safety and security certification package, with any exceptions documented.

Maintains safety oversight of the project tests, operations, or activities at a level consistent with the potential for loss over the life of the system.

Ensures that, in all instances, hazards are controlled or eliminated by corrective action with the following priorities:
Eliminate hazardous elements of subsystems within the design
Minimize or negate the effects of hazards through design techniques
Install safety devices
Install caution and warning devices
Develop administrative controls, including special procedures, access control systems/barriers
Provide protective clothing and equipment

Ensures that contractors and others supporting the project prepare a plan to address hazard analysis and resolution in their activities, which must be approved by the PMC, PMCS, PM and appropriate Project Manager, Design or designee.

Submits formal Hazard Reports and other documents for each hazard or safety issue with a residual risk to be formally accepted by management prior to contractual acceptance.

Provides the Program Director with assessments and briefings regarding security threats and vulnerabilities, technology and design evaluations, personnel requirements, and recommended counter-measures.

Attends reviews and management meetings on project development, acceptance, and operational readiness.

Reviews design concepts, preliminary schematics and technology to provide security evaluations and recommendations.

Reviews new security requirements and activities required to support design, construction, acceptance and operation of transit project.

Develops implementation strategies for new security related activities.

Develops schedules and resource allocations for implementation of new security activities.

Considers security aspects of facilities and vehicles; propose patrol strategies and security management systems.

Plans fiscal requirements of security activities.

Considers the security of passengers, vehicles and facilities in design and operational reviews.

Advises Program Director and PMCS on security and/or law enforcement contracts.

Determines training needs for security related activities.

Reviews, updates and revises SSMP and SSCP as required.
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- Develops resolutions for security problems identified.
- Determines security equipment needs.
- Meets with local police and other public safety organizations as needed.
- Solicits input from contractors and employees for improving security.
- Develops and maintains the requirements for CTfastrak construction safety and security requirements.
- Provides oversight of construction contractor and subcontractor safety and security data collection and recordkeeping, training, and compliance with their Construction Safety and Security Plans (CSSPs) and Health and Safety Plans.
- Attends construction contractor jobsite safety and security meetings as requested by CTDOT.
- Provides technical reviews of construction contractor safety and security deliverables including CSSPs, job hazard analyses, accident, incident and near miss investigations reports, and emergency response plans.
- Provides technical reviews of safety and security audit reports and Corrective Action Plans of Project jobsites submitted to the CTDOT by construction contractors.
- Conducts audits of construction contractor’s and subcontractors’ compliance with the CTDOT CSSP and develop Corrective Action Plans.
- Provides technical support for accident and near miss investigations performed by the CTDOT when it elects to perform its own independent investigation.
- Provides technical support for the CTDOT’s development of Corrective Action Plans resulting from accidents, near misses, or other construction contractor or subcontractor noncompliance issues.

3.2.2 Safety and Security Certification Review Committee

In July 2013, the SSCRC composition was re-evaluated to better support the impending transition of the CTfastrak Project to the operational readiness phase, resulting in a reconstituted committee as depicted in Figure 3-1. The Chair of the SSCRC is the CTDOT CTfastrak Program Director, and the figure further depicts the voting and non-voting members of the SSCRC.
The SSCRC’s SSC responsibilities and functions are discussed in the SSCP. In addition to those functions, the SSCRC is responsible for the following activities under the SSMP:

- Defining the organizational structure that the project will need in order to manage the identification and verification of safety and security requirements for the project in all phases.

- Defining safety responsibilities, assuring that system safety personnel and others have the authority to carry out these responsibilities, and documenting procedures to govern the interactions between these personnel and other organizational elements.

- Identification and provision of the resources that safety personnel will need to manage, perform, and verify safety requirements.
3.2.3 Fire/Life Safety Committee

The purpose of the Fire/Life Safety Committee (FLSC) is to serve as a liaison between the CTfastrak Project and the fire jurisdictions and emergency response agencies during the project development process. This committee is typically comprised of local and state fire jurisdictions, local emergency response agencies, the project operations and maintenance liaison, members of the PMSST, construction and design managers along with project management staff and the general design consultant. The FLSC is facilitated by the Program Management Operations Planning Lead – Graham Carey. The current composition of the FLSC includes:

- CTDOT – Security, Public Transportation and Operations Maintenance
- Capitol Region Council of Governments (CRCOG)
- Central Connecticut Regional Planning Agency (CCRPA)
- Amtrak
- Central Connecticut State University
- Municipal staff – Hartford, West Hartford, Newington and New Britain
- CT State Police
- Existing Corridor Operators – CTTransit, NBT and DATTCO
- TRA – Safety and Security Specialists

The committee reviews standards and safety-related designs and tests to verify fire/life safety code and regulation compliance. In addition, the committee reviews fire/life safety compliance documents and recommends resolution to the SSCRC for exceptions to the requirements. The Committee also assists the PMSST and the SSCRC in the:

- establishment of emergency training for bus transit and emergency response personnel;
- identification and resolution of fire/life safety hazards; and
development of emergency preparedness response plans, policies, and procedures.

The committee meets periodically to review proposed design changes that may affect fire/life safety, to debrief major incidents which involve emergency response agencies, and to plan emergency response drills and exercises. The committee reviews and recommends revisions to emergency preparedness response plans, policies, and procedures; operating procedures which affect emergency response; changes to training plans and training programs pertaining to emergency response and personnel; and fire/life safety design changes.

3.3 Approaches to Safety and Security Responsibilities

The CTfastrak Project PMC, PMD, PM, PMCS, in collaboration with the PMSST, are directly responsible for coordination and implementation of all the safety and security certification activities identified in this SSMP. Through all phases of the project: design, construction, testing, demonstration and start-up, the project managers:

- Advise project participants and stakeholders regarding safety and security certification requirements, hazard analysis, and the overall safety and security status of the project.
- Coordinate the system safety and security certification effort with systems engineering, civil structures, reliability and quality assurance, integration and testing, and program management functions.
- Identify necessary technical safety and security certification criteria and requirements (including those associated with interfacing hardware, software, and facilities) and ensures their incorporation into designs, specifications and planning documents.
- Ensure that submitted hazard reports contain sufficient information to permit the project management to make informed decisions.
- Review system safety and security certification tasks, prioritize safety and security risks, and recommend engineering, procedural, or other changes necessary to reduce the safety and security risk to an acceptable level.
- Ensure the implementation of a closed-loop process for providing traceability and tracking of all hazards from identification through resolution.
- Assist in coordinating safety and security committees and working groups (as necessary).
Participate in all major design reviews and provide lists of preliminary hazards, threats and system vulnerabilities and other safety and security concerns (with support of the PMSST); complete hazard analyses appropriate to the level of design detail; recommend corrective actions and controls, based on hazard analyses and sound engineering and management principles; and report and document on-going safety and security certification activities and concerns.

Participate in all major activities to review and accept the delivered project, system, sub-system or component, and provide a safety and security assessment and a safety and security certification package, with any exceptions documented.

Maintain oversight of project tests, operations, and activities at a level consistent with the potential for loss over the life of the system.

Ensure that, in all instances, hazards, threats, and vulnerabilities are controlled or eliminated by corrective action with the following priorities: eliminate hazardous subsystems within the design to minimize or negate the effects of hazards, threats, and vulnerabilities through design techniques; install safety and security devices; install caution and warning devices; develop administrative controls, including special procedures; and provide protective clothing and equipment.

Provide oversight of contractors and subcontractors conformance with all requirements of the project safety and security programs established by the contractor to comply with its CSSP and OSHA standards.

Submit formal reports and other documents for each hazard, threat, vulnerability, or safety/security issue with a residual risk to be formally accepted by management prior to contractual acceptance.
4 Safety and Security Analysis

The CTfastrak Project has adopted a system for assessing levels of risk and for determining what action(s) must be taken to correct and document the hazard risk, based on MIL-STD-882C. The risk assessment system meets APTA and FTA guidelines and has been incorporated into formal system safety analyses. The system enables project decision-makers to understand the amount of risk involved in accepting a hazard in relation to the costs (schedule, financial, operations, maintenance, etc.) to reduce the hazard to an acceptable level.

4.1 Objectives for Safety and Security Analysis

The CTfastrak Project requires safety and security analyses to ensure effective risk management for all high-consequence decisions that affect project design, construction, testing, acceptance and initiation into revenue service.

Risk management, when applied to safety and security decision-making is defined by FTA as:

"a structured system for measuring uncertainty in safety and security loss and evaluating corresponding impacts on project cost, schedule and performance to support sound decisions."

CTfastrak Project’s safety and security management function, through application of safety and security analysis techniques, provides a formal and documented process through which CTfastrak Project management evaluates and accepts risks for the project. This process is a consistent and vital component of the agency’s overall program for system safety and system security.

Application of safety and security analysis has been referred to as "investigation before the incident" or "troubleshooting before the trouble." The essence of this analysis for the CTfastrak Project is ongoing evaluation throughout the project to:

- identify hazards and vulnerabilities;
- translate them into risks;
- analyze, assess, and prioritize identified risks;
- resolve, accept or track identified risks; and
- document risk resolution, acceptance and tracking to closure.
In this manner, safety and security analysis provides a structured approach to considering and evaluating the following:

- potential sources of hazards and vulnerabilities in the project and corresponding transit operations;
- potential elements of the project or operation that could be affected (people, facilities, equipment, and the internal and external environments) by identified hazards and vulnerabilities, and qualified or quantified assessments of risk;
- potential configurations of the project or operation (available alternatives) to reduce risks; and
- documentation of accepted risk reduction anticipated for selected alternative(s).

Safety and security analysis can be applied to any phase of the system life cycle or to any evaluation of a design change or retrofit modification. The level of analysis to be performed is dependent upon the needs of the project and the parameters established by management.

Hazards and vulnerabilities can be identified and managed in a variety of ways:

- **Formal hazard and vulnerability analyses using the inductive process** to analyze system components to identify failure modes and effects on the total system, or a part thereof, or of personnel actions.
- **Formal hazard and vulnerability analysis using the deductive process** to identify sequential and concurrent states which are causally or conditionally required to support a specific effect.
- **Accidents or security incidents** that occur in similar operations or during the construction of the project.
- **Unsafe or non-secure conditions** identified as a result of facility inspections.
- **Unsafe or non-secure conditions or behaviors** identified as a result of employee or contractor observations.

The steps in the risk management process are depicted graphically in Figure 4-1 below.
Figure 4-1: Steps in the Risk Management Process

**STEP 1: Decide on Exposures**
- What is to be assessed?
  (Personnel, facilities, equipment, technology, operations, environment)

**STEP 2: Establish Authority and Responsibility for Analysis**
- Who identifies hazards and threats?
- Who sets policies and allocates resources?
- Who performs hazard and vulnerability analysis?
- Who accepts risk?

**STEP 3: Fix Risk Tolerance Limits**
- How much risk is acceptable?
- At what levels must risk be resolved?

**STEP 4: Perform Analysis to Identify**
- Hazards
- Vulnerabilities
- Over all life cycle phases
- Throughout project development and operation

**STEP 5: Assess Hazards and Vulnerabilities**
- Probability of occurrence
- Severity of occurrence

**STEP 6: Resolve Risk Associated with Hazards and Vulnerabilities**
- Design
  - Engineered and passive devices
  - Warning devices
  - Policies, procedures and training

**STEP 7: Verify Implementation**
- Countermeasures in place?
- Effectiveness?
- New hazards or vulnerabilities introduced?
4.2 Risk Tolerance in Safety and Security Analysis

All processes, mechanical, human or institutional, which can affect the safety and security of CTfastrak passengers, employees, contract employees, or the general public are considered safety-critical, and are subject to the practices outlined in this SSMP.

At no time will the CTDOT CTfastrak Project management, employees, or contractors, knowingly accept conditions with the potential to result in any of the following:

- Death
- Severe Injury (to one or more persons)
- Multiple Injuries
- System Loss (full or partial)
- Major system damage
- Major environmental impact

These limits, which guide acceptable parameters for design specification and project performance, are based on different justifications, including:

- formal analysis, in which cost-benefit tradeoffs are rigorously evaluated;
- professional judgment or assessments, provided by safety and security staff; engineering, operations and maintenance personnel and legal counsel;
- recommendations based on industry guidelines and standards;
- comparisons with similar transit operations;
- “bootstrapping” proposed new risks to ones that already exist; and
- value placed on public expectation and agency reputation.

This commitment to formal risk acceptance is generally reinforced through formal acceptance and sign-off policies for major findings and recommendations resulting from safety and security analysis. In this manner, the safety and security management function provides a formal process for safety and security analysis that:

- establishes a pre-determined level of safety and security, consistent with the agency’s function and service;
- incorporates this level of safety and security into acquisition and management practices;
- verifies agency compliance with safety and security requirements in acquisition and management activities; and
- ensures, in the reality of day-to-day operations, a reasonable and acceptable level of minimum risk is established for the project.
4.3 Characteristics of Effective Analysis

The safety and security analysis techniques used in the CTfastrak Project demonstrate the following characteristics:

- The risk assessment and analysis process is defined, using accepted methodologies, and documented in a plan that includes the criteria for acceptable risk as determined by CTfastrak Project management.
- Required hazard and vulnerability identification processes identify the actual risks associated with the system or operation under evaluation.
- Risks are effectively characterized in terms of severity of consequence and likelihood of occurrence.
- The findings of risk assessment conducted on identified hazards and vulnerabilities are compared to the acceptability criteria specified by management. The corresponding results are documented in a manner and method easily adapted for decision-making.

Decisions made regarding components of project design or operations which require determinations from CTfastrak Project management are supported with assessments sufficient to compare and contrast options.

Hazard management is the formal process of systematically recognizing, identifying, evaluating, and resolving hazards associated with the design, construction, testing, start-up, and operation of the project for patrons, employees, and general public. Recognized hazards must be identified and categorized as to their potential severity and probability of occurrence and analyzed for potential impact. Those hazards must then be resolved by design, engineering control, procedure, warning device, or other method, so that they fall within the level of risk acceptable to CTfastrak Project management.

The system safety approach encourages hazard management throughout the project’s life cycle. It is also recognized that hazard management is most effective when applied during preliminary engineering and final design. Hazard management must also be used to evaluate the safety impacts of deviations from the baseline design, construction change orders, equivalent methods of compliance, and other modifications made during construction, testing, and project activation.

Figure 4-2 presents a comprehensive process for identifying, resolving, and tracking safety hazards throughout all phases of project development activity. Managing hazards through identification, assessment, resolution, acceptance, or tracking is an essential function in design from concept through development. An effective hazard management program also provides a crucial tool for determining the safety impacts of engineering change proposals, construction change orders, operational equivalent methods of
compliance, and the issuance of temporary permits and certificates. All identified hazards related to the design, development, installation, operation, and testing of all critical system elements must be documented and eliminated or controlled in the SSC documentation process. This assurance verifies the safety of the system prior to revenue operations.

Figure 4-2: Safety Hazard Identification and Risk Acceptance Process

4.3.1 Identification

The definition of those conditions which have the potential for either causing an accident or creating an unsafe condition is the objective of the hazard identification function. Two basic strategies involve inductive and deductive processes. The inductive process, sometimes called “bottom up” methodology, involves the analysis of system components and their failure states to identify the effects on the total system. Inductive analyses determine the conditions that would be created if a part of a subsystem fails to operate when required, operates when not required, or operates improperly. The Failure Mode and Effect Analysis (FMEA) is the primary example of the inductive process. The item to be analyzed is first listed by its constituent major assemblies and then by its subassemblies and components. Each component is then evaluated to determine how it
could malfunction, what would cause it to malfunction, and the effect on the component, higher-level subassemblies, assemblies, and the entire item. Failure rates may then be determined and listed in order to establish the overall probability that the item will operate without a failure for a specific length of time and that the item will operate a certain length of time between failures.

The deductive process, or “top down” methodology, involves defining an undesired event (hazard) and then deducing the combinations of conditions and acts necessary to produce that hazard. It involves determining what combinations of “and” and “or” conditions of normal and fault events must exist to produce the undesired event. Fault Tree Analysis is representative of the deductive process.

The purpose of the Fault Tree Analysis is to provide a concise and orderly description of the various combinations of possible occurrences within the system which can result in an undesired event. This is the most rigorous of the hazard identification processes and analyses and should be reserved for the most complex systems. The Fault Tree Analysis requires training prior to use and involves expenditure of considerable resources to produce results. Fault Tree Analysis aids in the identification of potential problem areas in complex systems.

The most effective of the inductive or deductive methods should be used appropriately to identify hazards in each case. Several other inductive methods used are the Preliminary Hazard Analysis (PHA - identifies hazards based on failure modes and fault conditions of the known subsystems and components in the advanced stage of the design), System or Interface Hazard Analysis (SHA - identifies hazards in interface areas between subsystems and systems), and the Operations and Support Hazard Analysis (O&SHA - identifies hazards that may be induced by operators and system maintenance). All are matrix type analyses. Additional types of analyses, which may be used for hazard identification, include Software Hazard Analysis and Sneak Circuit Analysis.

Hazards and vulnerabilities are identified using methods established by the project. Typically, identification of hazards and vulnerabilities begins with the generation of a list of top-level hazards and vulnerabilities called a Preliminary Hazards and Vulnerabilities List (PHVL). The PHVL is the first step in the hazard/vulnerability analysis process, and includes a general listing of anything that can “go wrong” based on the design concept, its operation and implementation.

It identifies generic accident, crime and terrorism scenarios that may be associated with the project’s systems and sub-systems, components, procedures, and their subsequent interrelationships, providing an overview of the types of issues that must be considered in the design. It also pinpoints requirements for additional and more detailed analysis regarding the presence of hazardous conditions and vulnerabilities and the possibility for loss. In preparing the PHVL, in most instances, input from operating and
maintenance personnel, lessons learned from similar projects, combined with the assessments of design engineers and construction specialists, is sufficient to generate this initial listing. The PHVL provides the foundation for the Preliminary Hazard Analysis (PHA) that will be performed for the CTfastrak Project.

A PHA is a systematic, high-level examination of the proposed design to identify hazards to customers and employees which may exist within the proposed system. The purpose of the PHA is to develop safety design requirements for the system and to establish the framework for subsequent safety analyses. The PHA identifies potential hazards, assigns hazard severity and probability categories, and lists measures to reduce and/or eliminate the hazards. It is a qualitative, and to a certain extent, subjective means of identifying hazards and is conducted using experienced engineering judgment.

A PHA was performed at the onset of the final design phase of the project, consistent with the methods defined within the MIL-STD-882C. All hazards identified by the PHA and through all other project activities affecting design, construction, testing, operation and maintenance are analyzed, eliminated and/or controlled in accordance with these processes and this SSMP. Any project participant can provide additional inputs to the PHA at any time. The PHA included hazards identified from:

- lessons learned from other similar systems including historical information and operational data as well as pertinent safety criteria and studies;
- examination of energy sources (i.e., diesel fuel, overhead power lines);
- project technical specifications and design criteria;
- safety studies and analyses conducted for this and other projects; for example Fault Tree Analyses (FTA), Failure Modes and Effects Analyses (FMEAs), and Operations and Support Hazard Analyses (O&SHA);
- identification of safety-related interfaces among subsystems and system elements;
- evaluation of physical hazards such as shock, vibration, temperature extremes, noise, lightning and environmental hazards such as toxic substance exposure and hazardous substance releases and discharges;
- operating, testing, maintenance, and emergency procedures;
- major facilities and support equipment designs necessary to operate the system; and
- applicable codes, standards, and regulations.
The PHA forms the basis of the project hazard verification tracking log, which is managed by the PMSST through the SSC Program for each phase of the Project. Hazards and safety concerns from all sources, including other hazard analyses prepared by contractors or sub-contractors are incorporated into and tracked to resolution in the hazard log, which serves to verify that all identified potential hazards are adequately resolved prior to the start of revenue operations.

4.4 Safety Data Sources for Hazard Identification

A broad range of internal and external safety data sources will be utilized throughout the life-cycle of the CTfastrak Project for hazard identification. Each manager, supervisor, and contractor working on the CTfastrak Project cooperate with the SSCRC in instituting a systematic plan with required procedures for the identification of potential hazards through review of safety data sources within CTDOT and from other transit agencies that operate a BRT systems.

Internal safety data sources for hazard identification include but are not limited to:

- Hazard reporting forms
- Safety analysis (when conducted)
- Testing
- Inspections and audits QA/QC non-conformance reports
- Malfunction reports (for vehicles, facilities, systems and equipment)
- Preventive and/or corrective maintenance reports (as conducted by the Quality Assurance function of either Fleet Management or Project Support)
- Integrated communication center and control center daily logs
- Dispatcher reports passenger reports (corroborated by personnel reports)

External safety data sources, which may be reviewed for hazard identification, may include reports from other agencies, outside consultants, APTA, FTA, and NTSB.

The safety data collected from internal and external safety data sources are routed to the PMSST and SSCRC for evaluation of hazards. All CTfastrak Project personnel have access and input into the hazard identification and reporting process via the chain of command.

4.5 Areas for Hazard Identification and Analysis

Safety analyses used for hazard identification encompass all areas within the CTfastrak Project including, but not limited to, the following:

- safety analyses conducted by consultants and contractors on new construction and procurement programs;
 safety analyses conducted for Engineering Change Proposals (ECPs);
 fixed facilities inspected and analyzed for potential safety hazards;
 vehicles inspected and analyzed for potential safety hazards;
 equipment and subsystems inspected and analyzed for potential safety hazards; and
 operating and maintenance procedures including normal, abnormal and emergency procedures reviewed and analyzed for potential safety hazards. Safety hazards include CTfastrak Project occupational, and employee safety (human error, acts of commission, or omission) as well as system and passenger safety hazards.

In evaluating safety hazards to passengers and employees as a result of various energy sources, the following energy sources are considered:

 Kinetic
 Potential
 Mechanical
 Electrical
 Chemical
 Thermal
 Physical

4.6 Hazard Reporting and Tracking

A Hazard Report Form is used by all CTfastrak Project personnel to report hazards anywhere in the project.

The Hazard Analysis Tracking Document is the primary tool used by the SSCRC to identify, track, and resolve hazards. The PMSST maintains this document based on the PHAs. Upon completion of the PHAs, any program stakeholder can provide additional inputs. Hazards and safety concerns from all sources discussed in this section, including other hazard analyses prepared by the contractor or sub-contractors, are included and tracked to closure in the Hazard Analysis Tracking Document.
4.6.1 Hazard Categorization and Risk Assessment

A hazard risk (level of exposure) assessment procedure is required to establish priorities for corrective action and resolution of identified hazards. Because the priority for system safety is to eliminate hazards by design, a risk assessment procedure considering hazard severity will only generally suffice during the early design phase to minimize hazards. When hazards are not eliminated during the early design phase, a risk assessment procedure based upon the hazard probability as well as hazard severity and cost of corrective action, is required to establish priorities for remedial action and resolution of identified hazards.

The severity and probability classifications used are those currently adopted by the U.S. Department of Defense in MIL-STD-882C (1993), APTA, and the FTA.

For the CTfastrak Project, a comparative risk assessment process has been utilized. This process is based on the principles, descriptions, and definitions of MIL-STD-882C and enhances the risk assessment and prioritization by considering the cost of corrective actions.

The process codifies the hazard severity, hazard probability of occurrence, and the cost of eliminating or controlling the hazard, and ranks each element using established hazard rating tables. The process then determines which hazards are unacceptable or undesirable based on their severity and probability of occurrence. The hazard severity, probability, and cost combination for unacceptable and undesirable risk is then ranked on a Hazard Priority Rating Table, whereby CTfastrak Project management prioritizes and allocates the resources available to eliminate or correct the unacceptable and/or undesirable hazards.

4.6.1.1 Severity

Hazard severity categories are defined to provide a qualitative measure of the worst credible mishap resulting from personnel error, environmental conditions, design inadequacies, procedural deficiencies, system, subsystem, or component failure or malfunction as follows:

- **Category I: Catastrophic**: Death or system loss
- **Category II: Critical**: Severe injury, severe occupational illness, or major system damage
- **Category III: Marginal**: Minor injury, minor occupational illness, or minor system damage
- **Category IV: Negligible**: Less than minor injury, less than minor occupational illness or less than minor system damage
4.6.1.2 Probability

The probability that a hazard will occur during the planned life expectancy of the system can be described in potential occurrences per unit of time, events, population, items, or activity. Assigning a quantitative hazard probability to a potential design or procedural hazard may not be possible in all cases. A qualitative hazard probability may be derived from research, analyses, and evaluation of historical safety data from similar systems. Supporting rationale for assigning a hazard probability will be documented in hazard analysis reports. The qualitative hazard probability ranking, which will be utilized for the CTfastrak Project, is shown in Figure 4-3.

The assessment of probability of occurrence considers the actual size of the fleet inventory or items in the specific system under consideration based on the current system configuration. For example, the current fleet sizes of bus and non-revenue vehicles, entire inventory of Closed Circuit Televisions (CCTV), or pedestrian crossing signals will be considered when evaluating probability of occurrence of hazards in these populations.

Frequency of occurrence will also be evaluated for operating and maintenance employee safety-related activities. The hazard probability rating will estimate the likelihood of the hazardous conditions being experienced in the performance of specific employee duties and will consider the periodicity and total population of similar activities performed.

Additionally, frequency of human-induced fault conditions will be estimated based on systematic review of task and procedure complexity, person-machine interfaces, employee proficiency, and historical data of human-induced error-rates in similar operations (for example: 1/1000 errors per transaction, for given tasks, etc.). The following two aspects of potential hazards will be reviewed in human-induced fault conditions:

- the occupational health and safety hazard to the employee performing the task; and
- the system safety hazard that can be induced into the operating system as a result of employee act of omission or commission (for example: a maintenance-induced hazard by leaving jumper-wires in vital circuitry of signals, rendering it non-failsafe).

4.6.1.3 Categorization

As depicted in Figure 4-3, hazards with combination of severity and probability of occurrence 1A, 1B, 1C, 2A, 2B, and 3A are “unacceptable” and corrective action must
be taken to eliminate or control them by reducing the severity and/or probability of the hazard to an acceptable level. Priority rating for corrective action will be developed among unacceptable hazards using the cost of corrective action, as described herein. “Unacceptable” risks are comprehensively reviewed by the SSCRC. The SSCRC should advise the CTDOT Executive Managers of any hazard categorized as unacceptable and how the unacceptable hazard was or will be resolved. If the resolution of the unacceptable hazard is beyond the approval or budgetary authority of the Program Director, it should be submitted to the Executive Managers for an appropriate resolution.

Hazards with combination of severity and probability 1D, 2C, 2D, 3B, and 3C are undesirable. Acceptance of “undesirable” risk is determined and approved by the SSCRC. SSCRC decision is also required on the specific method of corrective action to mitigate the attendant risk, etc. Undesirable hazards should be slated for corrective action and should be prioritized based on the cost of corrective action within that level of criticality, in accordance with the method described herein.

Hazards with combination of severity and probability 1E, 2E, 3D, 3E, 4A, and 4B are “acceptable with review” by the SSCRC and concurrence of its membership. The SSCRC may accept the risk associated with retaining the identified hazard in an “as-is” condition with no further corrective action. Alternatively, CTfastrak Project management may prescribe periodic tests and inspections or other preventive measures to ensure, on a continuing basis, that the original severity and probability ratings are not invalidated over time by degradation of conditions in the subject item. Proper sign-off on the acceptance of the attendant risk is required.

Hazards with combination of severity and probability 4C, 4D, and 4E are “acceptable without CTfastrak Project management review.” Decision can be made by the CTDOT Project Engineer or during construction at the PMC (CTDOT Transportation Supervising Engineer) level.

4.6.1.4 Acceptance of Risk

Following their classification by severity and probability of occurrence, hazards will be given a general priority ranking, Hazard Risk Index (HRI) (Criticality), so that CTfastrak Project management can further assess them for two distinct, yet overlapping criteria:

- Acceptability of the risk to management from a safety-criticality standpoint and determination of the appropriate hazard risk index ranking. This priority ranking of a hazard is called its criticality and is a function of both severity and probability of occurrence. Assigning numeric values to each severity category and probability level and combining them mathematically can quantify criticality. Hazard criticality will be determined qualitatively. The hazard criticality ratings, for
Acceptability of risk by CTfastrak Project management, are classified in one of the following categories:

- unacceptable;
- undesirable project (management decision required);
- acceptable with project management review; and
- acceptable without review.

Determination of corrective action priority rating for unacceptable and undesirable hazards by considering the cost of corrective action. It should be noted that the hazard rating for priority of corrective action needs to be performed only for identified hazards that have been categorized as unacceptable and undesirable in the initial hazard risk index ranking.

Hazard criticality acceptance criteria: The process and algorithm for acceptance of risk follows the accepted practice of risk assessment described in MIL-STD-882C. Figure 4-3 depicts the hazard risk assessment matrix to evaluate acceptability of risk in identified hazards.

4.6.1.5 Resolution

The best method of resolving potential system hazards is to eliminate them. This may be impossible or impractical at times. Determination of the method to be employed can be made by conducting a thorough analysis of the system, considering the possible tradeoffs between various alternatives and the system safety requirements. The philosophy dictating these analyses should result in the resolution of alternatives. In general, accordance with MIL-STD-882C practices, leads to a number of different means that can be employed to resolve identified hazards. These include design changes, installation of controls and warning devices, and implementation of special procedures. Use of the Risk Assessment Matrix holds program management and technical engineering accountable for the risk of the system during design, testing and operation, and the residual risk upon delivery. The order of preference for the means used in resolving hazards for the project is as follows (Figures 4-4 and 4-5):
Figure 4-3: Hazard Risk Assessment Matrix and Acceptance Criteria

<table>
<thead>
<tr>
<th>Descriptive Word</th>
<th>Level</th>
<th>Within Specific Individual Items</th>
<th>Within a Fleet or Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent</td>
<td>A</td>
<td>Likely to occur frequently</td>
<td>Continuously experienced</td>
</tr>
<tr>
<td>Probable</td>
<td>B</td>
<td>Will occur several times in life of an item</td>
<td>Will occur frequently</td>
</tr>
<tr>
<td>Occasional</td>
<td>C</td>
<td>Likely to occur sometime in life of an item</td>
<td>Will occur several times</td>
</tr>
<tr>
<td>Remote</td>
<td>D</td>
<td>Unlikely but possible to occur in life of an item</td>
<td>Unlikely, but can reasonably be expected to occur</td>
</tr>
<tr>
<td>Improbable</td>
<td>E</td>
<td>So unlikely, it can be assumed occurrence may not be experienced</td>
<td>Unlikely to occur, but possible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency of Occurrence</th>
<th>Hazard Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>Catastrophic</td>
</tr>
<tr>
<td>(A) Frequent</td>
<td>1A-UN</td>
</tr>
<tr>
<td>(B) Probable</td>
<td>1B-UN</td>
</tr>
<tr>
<td>(C) Occasional</td>
<td>1C-UN</td>
</tr>
<tr>
<td>(D) Remote</td>
<td>ID-UD</td>
</tr>
<tr>
<td>(E) Improbable</td>
<td>IE-AC/WR</td>
</tr>
</tbody>
</table>

**Legend:**
- **Hazard Risk Index**
  - 1A,1B,1C,2A,2B,3A
  - 1D,2C,2D,3B,3C
  - 1E,2E,3D,3E,4A,4B
  - 4C,4D,4E
- **Acceptance Criteria**
  - UN-Unacceptable
  - UD-Undesirable (decision required)
  - AC/WR-Acceptable with review
  - AC-Acceptable without review
➢ **Design for minimum hazard:** (“D”, “E”) Design, redesign, refurbish, and retrofit to eliminate (i.e., “design out”) the hazards through design selection. This may be accomplished through the use of fail-safe devices and principles in design, the incorporation of high-reliability systems and components, and the use of redundancy in hardware and software design.

➢ **Safety devices:** (“S”) Hazards that cannot be eliminated or controlled through design selection should be controlled to an acceptable level through the use of fixed, automatic, or other protective safety design features or devices. Examples of safety devices include interlock switches, protective enclosures, or safety guards/barriers. Care must be taken to ascertain that the operation of the safety device reduces the loss or risk and does not introduce an additional hazard. Safety devices shall also permit the system to continue to operate in a limited manner. Provisions shall be made for periodic functional checks of safety devices.

➢ **Warning devices:** (“W”) When neither design nor safety devices can effectively eliminate nor control an identified hazard, devices should be used to detect the condition and generate an adequate warning signal to correct the hazard or provide for remedial action such as evacuation. Warning signals and their application should be designed to minimize the probability of incorrect personnel reaction to the signals and shall be standardized within similar systems.

➢ **Procedures and training:** (“P”) Where it is impossible to eliminate or adequately control a hazard through design selection or use of safety and warning devices, procedures and training shall be used to control the hazard. Procedures may include the use of personal protective equipment. Precautionary notations shall be standardized as specified by the SSCRC. Safety critical tasks and duties and activities throughout the project, such as bus operators’ duties, shall require organizational certification of personnel proficiency.

Note: The letters in parentheses (“D”, “E”, “W”, “S”, “P”) in each of the above bulleted paragraphs refer to the letters used at the end of each countermeasure listed in Figure 4-5.
Figure 4-4: Hazard Reduction Order of Precedence
### Figure 4-5: Sample Techniques for Resolving Hazards and Vulnerabilities

<table>
<thead>
<tr>
<th>Examples of Engineering Countermeasures:</th>
<th>Examples of Administrative Countermeasures:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fundamental design change (D)</td>
<td>• Abandon or shut down (P)</td>
</tr>
<tr>
<td>• Redesign vulnerable components (D/E)</td>
<td>• Relocate (D)</td>
</tr>
<tr>
<td>• Upgrade means of verifying</td>
<td>• Educate and train (P)</td>
</tr>
<tr>
<td>maintenance/operational adequacy</td>
<td>• Limit exposure time, duration, and/or distance (P)</td>
</tr>
<tr>
<td>(P)</td>
<td>• Provide employee supervision evaluation (P)</td>
</tr>
<tr>
<td>• Design/install redundant</td>
<td>• Provide warnings/sIGNALs and train in proper steps (W/P)</td>
</tr>
<tr>
<td>subsystems/assemblies (E)</td>
<td>• Maintain high housekeeping standards (P)</td>
</tr>
<tr>
<td>• Substitute or isolate (D/E/S)</td>
<td>• Design, train, and implement appropriate procedures for all operational activities and equipment (P)</td>
</tr>
<tr>
<td>• Insulate/shield (S)</td>
<td><strong>Other Example Countermeasures:</strong></td>
</tr>
<tr>
<td>• Test and monitor (P)</td>
<td>• Employ guards, require Identification (P)</td>
</tr>
<tr>
<td>• Reduce energy level (D)</td>
<td>• Use adequate security methods (light dark areas, use motion sensors on doors, windows, etc.) (W/P)</td>
</tr>
<tr>
<td>• Dilute or spread (E/P)</td>
<td>• Provide and require proper Personal Protective Equipment (PPE) (S/P)</td>
</tr>
<tr>
<td>• Exhaust or ventilate (S/P)</td>
<td>• Use locks, blocks, interlocks (S/P)</td>
</tr>
<tr>
<td>• Include adequate/sufficient sensors/alarms (W/P)</td>
<td></td>
</tr>
<tr>
<td>• Design to limit undesired production and emission of toxins and wastes (D/E/S/W/P)</td>
<td></td>
</tr>
</tbody>
</table>

Some available techniques are referred to as **ameliorators**. Ameliorators do not technically resolve hazards or vulnerabilities; instead, they control severity after an undesired event has begun. Examples include the following:

- Automatic sprinklers and fire extinguishers
- Providing and using personal protective equipment (PPE can also be a countermeasure)
- First-aid training
- Emergency preparedness
- Availability of first-aid kits, oxygen, antidotes
- Seat belts and crashworthiness provisions
4.7 Requirements for Safety and Security Analysis

The most common types of safety and security analysis which have been considered for the CTfastrak Project include the following:

- **Preliminary Hazard and Vulnerabilities List (PHVL)** – creation of a generic listing of hazards and vulnerabilities that may be present for the project – provides the foundation for the PHA and TVA.

- **Preliminary Hazard Analysis (PHA)** – the initial effort in hazard analysis during the system design phase or the programming and requirements development phase for facilities acquisition. It may also be used on an operational system for the initial examination of the state of safety. The purpose of the PHA is not to affect control of all risks but to fully recognize the hazardous states with all of the accompanying system implications.

- **Threat and Vulnerability Analysis (TVA)** – an analysis of the generic threats and vulnerabilities present in a system, their evaluation, and recommendations for control.

- **Subsystem Hazard Analysis (SSHA)** – performed if a system under development contains subsystems or components that when integrated function together in a system. This analysis examines each subsystem or component and identifies hazards associated with normal or abnormal operations and is intended to determine how operation or failure of components or any other anomaly may adversely affect the overall safety of the system. This analysis should identify existing and recommended actions using the system safety precedence to determine how to eliminate or reduce the risk of identified hazards.

- **System Hazard Analysis (SHA)** – accomplished in much the same way as the SSHA. However, as the SSHA examines how component operation or risks affect the system, the SHA determines how system operation and hazards can affect the safety of the system and its subsystems. The SSHA, when available, serves as input to the SHA.

- **Failure Modes and Effects Analysis (FMEA)** – a reliability analysis tool that is a bottom up approach to evaluate failures within a system. Any electrical, electronics, propulsion, or hardware system, sub-system can be analyzed to identify failures and failure modes.

- **Failure Modes, Effects and Criticality Analysis (FMECA)** – generated from an FMEA by adding a criticality figure of merit. These analyses are performed for
reliability, safety, and supportability information. The FMECA version is more commonly used and is more suited for hazard control.

- **Fault Tree Analysis (FTA)** – a deductive analytical tool used to study a specific undesired event. The deductive approach begins with a defined undesired event, usually a postulated accident condition, and systematically considers all known events, faults, and occurrences that could cause or contribute to the occurrence of the undesired event. Top level events may be identified through any safety analysis approach, through operational experience, or through a “Could it happen” hypothesis.

- **Terrorism Risk Assessment (TRA)** – methodology developed by the Department of Homeland Security specifically for use by transit agencies to evaluate the risk of terrorist events involving weapons of mass destruction (WMD) through comparison of relative risk between critical assets in order to identify and prioritize needs in terms of security countermeasures and emergency response capability enhancements.

- **Software Safety and Security Analysis (SSSA)** – performed to identify, categorize and resolve issues involving software, where software-controlled functions, if not performed or performed incorrectly, inadvertently, or out of sequence, could result in a hazard or vulnerability or allow a hazardous condition or vulnerability to exist, such as (1) software that exercises direct command and control over potentially hazardous functions and/or hardware, (2) software that monitors critical hardware components, and/or (3) software that monitors the system for possible critical conditions and/or states.

- **Operations and Support Hazard Analysis (O&SHA)** – performed primarily to identify and evaluate the hazards associated with the environment, personnel, procedures, operation, support, and equipment involved throughout the total life cycle of a system/element. The O&SHA may be performed on such activities as testing, installation, modification, maintenance, support, transportation, ground servicing, storage, operations, emergency escape, egress, rescue, post-accident responses, and training.

- **Health Hazard Assessment (HHA)** – performed to identify health hazards, to evaluate proposed hazardous materials that may be used in the project, and to propose protective measures to reduce the associated risk to a level acceptable to the grantee’s management.

Figure 4-6 presents the basic process through which safety and security analyses are integrated into the project development process. This process is flexible and responsive, and is guiding the CTfastrak Project. Thus far, the Project has used the
PHA and TVA processes, and will use other safety and security analysis techniques, as required, as the Project advances through implementation to operations.

**Figure 4-6: Safety and Security Analysis in a Major Capital Transit Project**

<table>
<thead>
<tr>
<th>Safety &amp; Security Analysis-Concepts</th>
<th>Preliminary Engineering</th>
<th>Final Design</th>
<th>Construction</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHA and TVA</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Inputs to Specifications</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety &amp; Security Analysis-Systems and Subsystems</th>
<th>Preliminary Engineering</th>
<th>Final Design</th>
<th>Construction</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revise PHA/TVA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSHA, FMEA, FMECA, FTA, TRA &amp; SSSA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inputs to Design, Procedures, Test, Training, Manufacturing &amp; Assembly</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety &amp; Security Analysis-Personnel, Procedures And Equipment</th>
<th>Preliminary Engineering</th>
<th>Final Design</th>
<th>Construction</th>
<th>Operations</th>
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</thead>
<tbody>
<tr>
<td>SHA, Updated FEMA, FMECA, FTA, TRA &amp; SSSA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inputs to Design, Changes, Training &amp; Procedures</td>
<td></td>
<td></td>
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</tbody>
</table>
4.8 Security Threat and Vulnerability Management Process

Threat analysis includes examining the system infrastructure and actually determining threats to which a particular component or element is vulnerable. The emphasis of the analysis is on correlating and linking threats to specific system elements to ensure proper use of security resources, including budgets, time, people, and equipment.

The vulnerability analysis consists of a series of activities intended to identify security-related shortcomings or weaknesses in the proposed system. The process for determining vulnerabilities in the proposed system begins with the identification and grouping of project assets to enable management to rank system components based on their criticality to transit operations, their attractiveness as targets for security breaches or terrorist attack, and their vulnerability to the impacts of a successful breach or attack. Critical assets are defined as the specific assets most critical to its mission to protect people and the agency’s ability to provide service. The process for Threat and Vulnerability Management that has been used for the CTfastrak Project is summarized in Figure 4-7.

Figure 4-7: Threat and Vulnerability Management Process
Once critical assets were identified, the project undertook a “threat and vulnerability resolution process”—similar to the hazard analysis performed for safety critical elements—to identify and evaluate the vulnerabilities of these assets to specific threats, and to promote reasoned decision-making which balances risk against the cost of protective design countermeasures. The overall assessment concluded with security recommendations regarding the control and/or mitigation considerations for project design. This process provided management with answers the following questions:

- Identification and characterization of the threats to specific assets. What are the threats to the system? How can these threats be described and quantified in terms that support management decision-making activity?
- Identification and characterization of the vulnerability of specific assets. What vulnerabilities exist that could be exploited? Can the project make design changes to reduce risk levels by altering the nature of the asset itself? Are there additional procedural, technology or equipment measures that would reduce vulnerability? Should special activities be performed to improve emergency preparedness as a result of the vulnerabilities of the asset?

The process resulted in security design features and operational recommendations to address the identified system vulnerabilities, similar in logic to the previously discussed hazard reduction process.
5 Development of Safety and Security Design Criteria

5.1 Approach to Development of Safety and Security Design Criteria and Specifications

Safety and security design criteria provide an organized listing of safety and security codes, regulations, rules, design procedures, recommended practices, handbooks and manuals prepared to provide guidance to project designers in the development of technical specifications for the CTfastrak Project. These criteria are intended to ensure that safety and security are "designed into" the project. In this section, the approach to the creation of safety and security design criteria for the CTfastrak Project is described. Figure 5-1 provides a visual illustration of this process.

Figure 5-1: Safety and Security Analysis in the Design Process

Figure 5-2 depicts the incorporation of safety and security into the final design process, which began with the project definition and general description of the project stemming from Alternatives Analysis phase. Using these inputs, the project team established the basic scope of the project (i.e., double lane alignment operating within a specific corridor over a fixed distance and serving a designated number of stations, with parking lots). Once the scope was established, a preliminary list of components was identified,
including all of the elements which were designed for the project (i.e., CTfastrak stations, ITS, communications systems, parking lots).

**Figure 5-2: Incorporation of Safety and Security into Final Design Process**
As part of its preliminary and final design phase, applicable codes, guidelines, and regulations to which the CTfastrak project was to be designed, constructed, operated and maintained were identified. The identification of such information facilitated the development of project specific design criteria and technical provisions, which have been used to incorporate the identified requirements into all aspects of design, architectural concepts, specification preparation, equipment selections, construction, testing, and operation. Sources of this data include:

- Technical specifications from previous contracts
- Existing agency design and performance criteria
- Applicable codes, standards, etc. defined by standards boards and organizations
- Regulatory directives and requirements
- Project performance requirements
- Requirements derived from previously performed safety/security studies
- Pertinent safety and security criteria and studies from other transit systems

Applicable standards, codes, and requirements are derived from several sources including:

- CTDOT Bridge Design Manual
- CTDOTBusway Design Manual
- CTDOT Highway Design Manual
- American Association of State Highway Transportation Officials -- [http://www.aashto.org](http://www.aashto.org)
- Americans with Disabilities Act (ADA)
- American Institute of Architects -- [http://www.aia.org](http://www.aia.org)
- American National Standards Institute (ANSI) -- [http://www.ansi.org](http://www.ansi.org)
- American Society of Civil Engineers (ASCE) -- [http://www.asce.org](http://www.asce.org)
- American Society for Testing and Materials (ASTM)
- California Public Utilities Commission -- [http://www.cpuc.ca.gov](http://www.cpuc.ca.gov/)
- Environmental Protection Agency -- [http://www.epa.gov](http://www.epa.gov/)
- Factory Mutual (FM) -- [http://www.factorymutual.com](http://www.factorymutual.com)
- Federal Motor Carriers Safety Standards (FMCSS)
- General Services Administration -- [http://www.gsa.gov](http://www.gsa.gov)
- Illuminating Engineering Society (IES) -- [http://www.iesna.org](http://www.iesna.org/)
Specifically for security:


- Other recommendations for designing security into projects, for managing sensitive security information (SSI) during projects, and for developing appropriate procedures and policies for operational security can be found at: [http://transit-safety.volpe.dot.gov/security/SecurityInitiatives/Top20/](http://transit-safety.volpe.dot.gov/security/SecurityInitiatives/Top20/).

- The Transit Cooperative Research Program (TCRP) has sponsored a number of projects evaluating security technology and procedures for their effectiveness in the transit environment, available at: [http://trb.org/SecurityPubs](http://trb.org/SecurityPubs).


Once codes, standards, regulations and recommendations were identified and organized according to the appropriate project components, they were delivered to the project design team for early integration into design activities. They were also assessed against the PHA to ensure that potential scenarios identified in the PHA are adequately addressed by the proposed listing of codes, standards and regulations.

Design criteria for the project defined the various safety and security features and requirements which must be incorporated into the completed system. The requirements were subject to review and revision, by prescribed procedure, as the design evolved. Proposed changes to the criteria were required to be submitted formally via a design review and comment form to the SSCRC. The SSCRC evaluated each proposed change prior to making any revision to the design criteria. Strict configuration management processes were used and only a limited number of approved personnel had access to the working document. All other personnel were notified of changes to the design criteria through the established chain of command and communication procedures.
All preliminary and final designs have been thoroughly reviewed by Project Engineering, PM, PMSST, Quality Assurance, and management personnel to ensure all design criteria requirements have been achieved. These reviews took place at the 30%, 60%, 90%, and 100% design development stages. During this phase, the SSCRC discussed and worked to identify, evaluate, and resolve project system safety, safety certification, fire/life safety, security, and systems assurance issues and resources. SSCRC members reviewed all design submittals and provide comments through the design review process.

Concurrent with this activity, the PMSST worked with contractors and the design team to further refine the project component lists and to review this list to identify safety and security certifiable elements. These elements are defined as:

“Facilities, equipment, procedures, training programs or other components considered critical to the safety and security of a system, and whose inclusion in the project must be certified by the grantee using appropriate verification procedures.”

Also during this process, requirements for general tests, inspections, integrated tests, demonstration/acceptance tests, and operations and maintenance plans, procedures, training and rulebooks have been developing, which will demonstrate the effective realization of the specification in the as-built project and delivered systems.

As the design effort proceeded to greater levels of specification, the safety and security design criteria were translated by the CTfastrak Project final designers from general codes and standards to specific requirements for each identified project component (Figure 5-3). Throughout this process, CTfastrak Project engineers had access to support in referencing, reviewing and/or interpreting the safety and security design criteria.

Results from safety and security analysis were integrated into the specification process through delivery of reports and analyses documenting the consequences of specific project decisions for safety hazards and security risks.

Prior to the initiation of revenue service, a Certificate of Compliance should be issued by the SSCRC for each identified element, verifying its conformance with safety and security requirements and its readiness for initiation into revenue service.

Identification of safety and security certifiable elements enabled the PMSST to define the project in organizational categories that can be further sub-divided to support recognition of individual sub-elements and items with the potential to affect safety and security.

These sub-elements and items were then documented in a Safety and Security Certifiable Items List (CIL). The process of “breaking down” certifiable elements into CILs occurred simultaneously with the project team’s engineering effort.
Figure 5-3: Specification Development Inputs

- Experience
- Constraints
- Standards and codes:
  - MIL STDS/
  - Commercial stds
  - ANSI STDS
  - ASTM STDS
  - NFPA Codes
  - BOCA
  - PROJECT Guidelines
- Project material selection
- Emergency planning

Prespecification analyses

- Criteria
- Specification
- Resources available:
  - Dollars
  - People
  - Time
5.2 Design Reviews

Administration of the Design Review Process occurred as outlined in the Design Phase Organization, Chapter 9 of the PMP. These reviews occurred in accordance with the Work Plans, Scope of Service, and the Project Schedule.

The PM and Final Designers will submitted preliminary and final design work packages to CTDOT’s CTfastrak Project Managers, Design (PMD). The PM received a copy of the Final Designer's work for its review. The Consultant Design Division assisted the CTfastrak PMD in coordinating a post-review meeting and distributed work packages to the Design Services Division, Traffic Division, etc. for review. The PM performed an independent peer review on CTDOT’s behalf. Participants in post review meeting were determined by the respective managers. To expedite the review process, individual task deliverables required as part of the Design were submitted to CTDOT for review as they were completed. Concurrent submissions were made by the PM and Final Designers to outside agencies, such as FRA and FHWA, in order to solicit comments and advance the schedule for Design. Review meetings were sometimes scheduled, where deemed appropriate, to discuss complicated design issues. These meetings included the CTDOT CTfastrak Project PMD, PMC, PM, PMCS, Final Designers and other team members as needed, and outside agencies, depending on the design to be reviewed.

Several activities were conducted to assure that designs achieved safety requirements. All facilities and system designs for safety input were reviewed by the PM, PMCS, PMSST, CTfastrak Project staff, and contractor staff. Disposition of comments are resolved through the project’s design review process. In addition, designs were formally certified and safety items were identified through standards and requirements. Industry standards and experience were also used to evaluate unique issues related to transit safety. In several cases, special studies or analyses were performed to address specific safety issues.
6 Process for Ensuring Qualified Operations and Maintenance Personnel

6.1 Operations Personnel Requirements

Operations on the CTfastrak BRT may be coordinated by a new entity or under the auspices of CTTransit, but for now will be known as the Busway Operations Center (BOC). This organization will communicate with transit providers and serve as a point of contact with municipalities and local emergency services when necessary. The BOC will monitor operations along the CTfastrak BRT for both revenue-service and maintenance vehicles.

6.1.1 Field Supervision of Operations

The COO will hire and train a team of supervisors to oversee operations in the field. Field supervisors, working with dispatchers, will manage CTfastrak BRT service quality to ensure an optimal riding experience for users. Under their supervision transit operations will be observed and modified to ensure efficient operations. Supervisors will carry out dispatch instructions from the BOC in person to increase their comprehension and effectiveness. They will respond directly to incidents and emergencies and communicate directly with drivers. Each supervisor will manage multiple operators, enforcing common operating procedures and providing an interface between CTfastrak and roadway operations. Supervisors will oversee a shift of operators and operations personnel, ensuring compliance with rules and procedures, maintaining schedules, monitoring communications, and route staffing. Supervisors may be required to operate buses, train subordinate personnel, and to respond to inquiries from various agencies.

- Hiring of supervisors must occur far enough in advance of the CTfastrak BRT opening to assure proper training.
- It will also be necessary to hire supervisors capable of performing the duties required, including the oversight of multiple operators and operation of transit vehicles as needed.

6.2 Maintenance Personnel Requirements

6.2.1 Roadway Maintenance:

CTDOT will be responsible for the maintenance of the roadway, curbs, structures, operational signage, and other physical infrastructure. Also, the agency will be responsible for maintenance of lighting, signals, roadway loop detectors, transit priority
and related equipment. When necessary, the agency will perform CTfastrak roadway snow removal operations and will handle the response to emergency roadway occurrences. The operating procedure for CTfastrak BRT emergencies will be in accordance with CTDOT’s established response to incidents on state highways. Also, it will be important to secure a contractor to provide 24-hour on-call towing services for disabled buses and other vehicles.

The CTDOT Maintenance Division currently has trained and skilled personnel along with equipment to maintain state highways. Given that the CTfastrak BRT is owned by the agency and similar in design to state highways, agency personnel are most qualified to maintain the CTfastrak roadway.

6.2.2 CTfastrak Maintenance Organization

Maintenance of on-site CTfastrak assets – station structures, parking and ITS components – has not been established at this point in the project. Recommendations to accomplish these functions include establishing a CTfastrak BRT maintenance organization (BMO). This organization would assume responsibility for these maintenance requirements together with CTDOT. A decision needs to be made on what organization should take on the BMO responsibility, CTDOT, CTTransit, a new public entity or a private contractor.

The BMO’s responsibilities will include maintenance of station platforms, passenger shelters, lighting, communications, security cameras, emergency call boxes, real-time passenger information display boards (including next bus information), and other electronic services. The BMO will be responsible for updating signage both in and out of the stations including parking lots. The BMO will remove graffiti from all surfaces of the building, platforms, trash containers, lighting fixtures and signs. The BMO will be responsible for removal of snow from platforms to ensure the safety of transit patrons.

The primary BMO must have the expertise and knowledge to provide the services and amenities to encourage transit ridership. In the case of the CTfastrak BRT, the BMO should analyze the most efficient and cost effective means of providing services and maintenance for the stations.

6.3 Plans, Rules and Procedures

To ensure consistency, common operations procedures must be developed. The COO will be responsible for the development of written operations material and standard procedures, with support from the various transit operators using the CTfastrak BRT. All staff will be trained in their respective areas of responsibility, including dispatchers, field supervisors, and drivers. All operators on the CTfastrak BRT will receive instruction and training on proper procedures, including safety training and service interruption and recovery.
It will be necessary to ensure that maintenance responsibilities, standard highway maintenance procedures and all other requirements be clearly specified in written agreed upon directives. Coordination will be required with Amtrak and its maintenance division clearly specifying maintenance responsibilities where the CTfastrak BRT and railroad right-of-way abut, or in shared areas adjacent to the roadway.

6.4 Training Program

It is important to note that, because training on equipment such as buses, ticket vending machines, and dispatch systems must involve the actual equipment, this activity can only be completed after the equipment has been procured and installed. Equipment vendors will be involved to a significant extent in this activity, with the final development of training procedures and written manuals to be completed in cooperation with them and with equipment manufacturers. This training should be included in procurement contracts with vendors. Training must begin well in advance of the opening of the CTfastrak BRT to ensure a seamless transition to the new facility.

The BMO will be responsible for creating training programs including repair and maintenance of the bus roadway, snow removal, lighting and signals, buildings and shelters, landscaping, fare vending machines, security cameras, passenger real-time information boards, vehicles and electronic equipment to name a few. Also, special training will need to be conducted for personnel working in the CTfastrak BRT rights-of-way to ensure safety procedures are employed. The BMO may work closely with equipment vendors and manufactures to set up the training programs and may contract out some of the training to these entities.

Training programs should be developed for the numerous tasks to be performed including equipment maintenance and operation in accordance with manufacturers’ specifications. It will also be necessary to determine what agencies are best suited to perform specific training sessions. Programs must be developed in advance of the CTfastrak BRT opening to assure a fully staffed BMO when the CTfastrak BRT opens.

Bus operators are an important element of the safety and security function. They will be provided FTA and National Transit Institute (NTI) training on the detection of and communication to the BOC of suspicious activity.

6.5 Emergency Preparedness

CTDOT will handle the response to emergency roadway occurrences. The operating procedure for CTfastrak BRT emergencies will be in accordance with CTDOT’s established response to incidents on state highways. Also, it will be important to secure a contractor to provide 24-hour on-call towing services for disabled buses and other vehicles.

To respond to incidents that may occur on the CTfastrak BRT or at its facilities, emergency services jurisdictions are defined as the areas to which specific responders
will reply in the event of fire or a medical emergency, a crash, natural disaster, or other emergency. These areas correspond with the areas in each municipality through which the CTfastrak BRT will pass. Each municipality will respond to emergencies within their jurisdiction along the CTfastrak BRT. Each municipality will have access to the CTfastrak BRT at one or more locations.

To successfully implement a comprehensive set of safety and security procedures for the CTfastrak BRT requires an equally comprehensive training program for those who must respond to incidents. Procedures and training must be developed for all CTfastrak BRT security functions in advance of the opening of the CTfastrak BRT.

CTDOT will develop a training program for all police, fire, and emergency services personnel who will provide services to the CTfastrak BRT. Such training will familiarize emergency service personnel with the physical layout of CTfastrak BRT facilities, as well as with CTfastrak BRT operations and service patterns. It will include appropriate drills and exercises to test responders in adherence to emergency procedures.

To assist in the process of planning and training for safety and security issues, FTA, the Transportation Safety Institute (TSI) and Transportation Security Administration (TSA) sponsor training courses on transit safety and security issues. These will be considered for the CTfastrak BRT staff and emergency responders. The FLSC will develop crisis management protocols for addressing safety and security incidents on the CTfastrak BRT.

Successfully addressing safety and security along the CTfastrak BRT requires building on existing local organizations, such as police, fire and EMS. Ensuring the implementation of these tasks will be the responsibility of the FLSC, which will facilitate continued coordination through opening day.

### 6.6 Public Awareness

Prior to beginning of construction, CTDOT initiated a Public Awareness Program to warn the communities adjacent to the CTfastrak Project of the potential dangers of the construction activities and to heed signs and fences erected to protect the public. As the CTfastrak Project nears the start of revenue operations, public awareness outreach will include information: that the CTfastrak BRT is restricted to authorized vehicles, information regarding CTfastrak BRT grade crossing signals, and the safety and security of the multi-purpose trail.
7 Safety and Security Verification Process (Including Final Certification)

7.1 Safety and Security Certification Process

The core of the CTfastrak Project’s SSMP is the Safety and Security Certification (SSC) Process, which is designed to document that:

- safety-related requirements are incorporated into every applicable aspect of the project including design, construction, testing, operation, and maintenance;
- tests are conducted to verify the ability of equipment and personnel to function safely;
- plans, procedures and training programs are developed, thoroughly reviewed, and implemented prior to the start of revenue service; and
- responsible program participants verify the above are completed in order to provide a traceable history of the SSC program.

In accordance with the FTA Handbook for Transit Safety and Security Certification, the CTfastrak Project has developed a Safety and Security Certification Plan (SSCP), which defines the roles and responsibilities of project personnel within the certification process. The SSCP also details the tasks to be performed during the course of the project to ensure SSC requirements are met. Much of the information in this section was excerpted from the SSCP. More detailed information on the Ten Major Steps of SSC can be found in Section 4.0 of the SSCP.

The SSC process (Figure 7-1) is managed by the Program Director with the PMSST having oversight and final approval responsibilities for all certification activities. Ultimate certification of the completed system’s readiness for safe operation is the responsibility of the Program Director with the concurrence of the SSCRC. The purpose of the SSC Process is to:

- identify and document design decisions regarding safety, fire/life safety, and security;
- identify and review compliance with safety and security requirements applicable to the project;
- create a list of hazards, safety certifiable elements, and potential threats and vulnerabilities;
- analyze and mitigate or eliminate identified hazards, threats, and vulnerabilities;
- verify that safety and security certifiable elements have met the requirements of the SSCP;
assure to the maximum extent practical that safety, fire/life safety, and security activities and requirements are integrated into the design, construction, testing, and activation phases of the project;

provide a process for documenting, verifying, and demonstrating compliance with safety, fire/life safety, security, and specification requirements throughout all project phases;

ensure the identification, elimination, and/or control of hazards throughout all project phases;

provide a process for demonstrating the effectiveness of hazard controls and countermeasures implemented to eliminate and control hazards;

document and verify the analyses, review, and approval process to ensure appropriate system safety and security requirements are included across the whole system including station, vehicle, and facility design criteria, construction plans and activities, testing programs, operating procedures, training programs and maintenance manuals;

ensure that the project and outside emergency response agencies are prepared and capable of responding to normal, abnormal, and emergency situations involving the project;

implement a process for systematically reviewing and documenting tests, analyses, inspections, audits, and review results in a format that clearly displays the successful completion of the SSC Program for presentation to project management, FTA, or other interested agencies or parties;

evaluate safety and security critical functions or equipment with vital functions affected by additions, deletions, substitutions, rebuilding, replacement, modification, or new designs associated with the project to identify and resolve potential hazards through a hazard elimination/reduction process.

verify that all hazards, threats, and vulnerabilities are documented in hazard analyses and threat and vulnerability analyses have been eliminated or controlled; and

prepare a SSC Report detailing program outcomes.

The SSC process is the means through which identified project safety and security elements are monitored, inspected, audited, and documented to evaluate their effectiveness. The process applies to all CTfastrak Project personnel, including consultant and contractor staff and all elements, equipment, processes, and procedures of the CTfastrak Project. The SSC process is also the means through which CTDOT verifies that all essential parties to the CTfastrak Project have developed rules, policies, and plans in accordance with this SSCP and the CTfastrak SSMP.
Figure 7-1: Verification of Safety and Security Requirements in Transit Projects

Certifiable Elements

PROJECT PERFORMANCE

- Design Criteria Conformance
- Construction Specification Conformance
- Testing, Inspection Conformance
- Risk Resolution Conformance
- Rules and Procedures Conformance
- Training and Exercises Conformance

PROJECT SAFETY AND SECURITY CERTIFICATE

Final Verification Report
At the completion of the project, and prior to the start of revenue operations, the SSCRC, with the assistance of the PMSST, issues Certification of Compliance for the project. In addition, the PMSST develops a comprehensive final SSC Report. This report details the certification process, its outcomes, any remaining open items and the rationale as to why they remain open, and signed certificates of compliance authorizing the system ready for initial operation.

7.2 Safety and Security Certification Review Committee

The safety and security management activities of the SSCRC have been described earlier in this SSMP, as well as the current composition of the recently reconstituted committee. This section describes the SSC responsibilities of the committee. The SSCRC is chaired by the Program Director and acts as a SSC working group.

The SSCRC oversees the administration of the hazard identification, analysis, and resolution process and works to ensure that all hazards, threats and vulnerabilities identified during design reviews, material and hardware selection, assembly and integration, audits, inspections, testing, etc. are resolved and appropriately documented prior to the start of revenue operation. The SSCRC meets on an as-needed basis, but no less than once per month. The SSCRC serves as a liaison between the project and the external emergency response agencies, and reviews, analyzes, and directs activities related to the fire/life safety and security aspects of the project. The SSCRC further identifies the emergency response needs (such as training, drills) that are required to adequately respond to accidents/incidents that may occur during each phase of the project including operations and maintenance. The SSCRC also provides expertise to facilitate the development and implementation of emergency responder training programs and activities, and emergency operating procedures and plans.

Specific SSC tasks and activities for which the SSCRC is responsible include:

- identifying and reviewing compliance with safety and security requirements applicable to the project;
- creating a list of hazards, safety certifiable elements, and potential threats and vulnerabilities;
- analyzing and mitigating or eliminating identified hazards, threats, and vulnerabilities;
- verifying that safety and security certifiable elements have met the requirements of the SSCP;
- documenting and verifying the analyses, review, and approval process to ensure appropriate system safety and security requirements are included across the whole system including station, vehicle, and facility design criteria, construction plans and activities, testing programs, operating procedures, training programs and maintenance manuals;
- verifying that all hazards, threats, and vulnerabilities are documented in hazard analyses and threat and vulnerability analyses have been eliminated or controlled; and
7.3 Design Criteria Verification Process

During design, the Project Managers, PM, and PMSST identified criteria requirements for certifiable elements and items. This process involved the creation of a checklist for each certifiable element to record requirements generated from safety and security design criteria and the Busway Design Manual. These checklists, referred to as “Design Criteria Conformance Checklists (DCCC),” provided a format to verify compliance with identified safety and security requirements.

In the certification process, contract specifications, design criteria, the Busway Design Manual, applicable codes, and industry standards supported this verification. For example, some of the requirements in contract specifications may have been used as verification, such as maintenance manuals, subsystem hazard analysis, and factory test reports. Other requirements may not take the form of specific deliverable documents but require field visual inspection verification.

Following initial development, the DCCC was submitted to the SSCRC for review and comment. Recently, the PMSST reviewed the current status of the DCCCs and provided to the reconstituted SSCRC for their review and comment/approval of current status.

During development of these checklists, the project team referenced safety and security requirements for use in design reviews and during inspections or tests.

To initiate activities to verify compliance of the delivered project with criteria and specifications developed and approved during design reviews, formal documentation is obtained from the responsible design and construction managers, to demonstrate:

- all elements of the system provided under construction, procurement and installation contracts conform to the specifications;
- the as-built configuration contains the safety and security related requirements identified in the applicable specifications and other contract documents; and
- changes to the established design configuration meet code and regulatory compliance, and identified fire/life safety issues are also resolved.

7.4 Construction Specification Conformance Process

Specification Conformance is performed to establish a formal process to verify that all safety and security-related specification and contract document requirements are satisfied during design, construction, installation, and testing.
Many of the safety and security requirements in the specifications take the form of specific deliverables, such as manuals, hazard analyses, reports, approved contract submittals, factory test procedures results, and inspection reports. However, other safety requirements may not take the form of specific contractor or in-house deliverable documents but still require verification via field inspections with reports and photographic evidence. Compliance with these types of safety and security-related requirements are subject to verification during design reviews, audits, inspections and tests.

The methodology utilized by this process is three-fold:

- verify the design phase;
- verify the construction, installation, and test phase; and
- perform final verification phase (verify that all the documentation is complete and filed).

Specification Conformance Checklists are utilized to ensure the verification is effectively documented. The completed Specification Conformance Checklist, in conjunction with the DCCC, provides comprehensive documentation of the verification process.

### 7.5 Testing/Inspection Verification

To achieve this verification, the design and hazard and vulnerability management processes will be coordinated with activities managed by other project functions to support development and implementation of the project Testing Program. A comprehensive Quality Assurance and Control (QA/QC) program addresses elements critical to safety and security. Specific QA/QC activities for the Testing Program will be guided by a detailed Testing Program Plan (TPP), which will be prepared prior to Testing and Start-up Activities, and which will clearly identify all safety and security conformance tests.

During the construction, start-up and activation phases, many contractual and integrated tests will be conducted for the purpose of validating proper operation of equipment being furnished and constructed for the project. The PMSST and members of supporting committees will participate in testing whenever SSMP related activities are an integral part of the testing programs including acceptance, pre-operational, and start-up tests.

The PMSST will assist in the development of integrated test plans and procedures for system verification and demonstration for both acceptance and system-level tests for safety and security features, such as sprinkler systems, alarms, emergency management panels, fire management panels, ticket vending machines, and CCTV systems.
Contractor and integrated testing requirements should be reviewed for safety and security considerations. Contractor testing, as required by the contract specifications, verifies the functionality of the involved system or equipment. Integrated testing verifies the functional interface between different equipment and systems. Both contractor and integrated testing are subject to certification. Certification of contractor testing may be verified in the Specification Conformance Checklist, combined with integrated testing in a test program certification, or other acceptable means.

The need for additional tests may arise for various reasons throughout the project. To request and record the performance of additional tests, the project team may prepare a formal test description sheet and submit it to the appropriate organizational unit managing the test program plan.

Once the project moves into its construction phase, the certification process moves into testing and verification mode. This mode focuses on verification that the project’s safety and security criteria and safety and security related requirements are satisfactorily incorporated into the finished project.

The Specification Conformance Checklist tracks the testing or verification activities that corroborate conformance. Typical contractor tests called for in the contract specifications include qualification, manufacturing, performance and acceptance tests.

Visual inspection reports are used to verify safety requirements that are not verified with specific tests or other documentation. The completed form indicates the Certifiable Element/Sub-item, contract number, safety requirement, associated number on the checklist, and any comment necessary to indicate conformance. The individual performing the inspection signs and dates the form.

As the checklist is being completed, the PMCS, with PMSST support, prepares a binder that is used to organize the needed verification documentation. The PMCS collects the necessary documentation (e.g., submittal approvals, mill certifications, inspector reports, job photos, and visual inspection reports) to verify each item on the checklist.

As certification activities advance on each contract, the PMCS, with PMSST support, also keeps track of any open items that are lagging in certification documentation or experiencing problems achieving certification. These open items are periodically forwarded to the SSCRC for guidance or resolution.

During construction, the need for tests in addition to those specified in contracts might arise. In these cases, CTfastrak Project staff will review the need of the additional tests and determine if any additional tests will be performed. If approved, the additional tests shall be included in the Specification Conformance Checklist and their results documented.

The SSCRC will monitor the progress on the various checklists on a periodic basis. The CTfastrak Project’s Quality Assurance staff may be asked to review the checklists and
their documentation from time to time and report the findings to the Project Managers and the SSCRC. This step will ensure that the documentation effort is keeping pace with the testing program so that the necessary validation materials are completed in a timely manner.

During the construction and start-up phases, many contractual and integrated tests are conducted for the purpose of validating proper operation of equipment furnished and constructed for the CTfastrak Project. The PMSST may observe testing whenever safety-related activities are an integral part of the testing programs, including installation, verification, and acceptance, pre-operational demonstration, system integration, and start-up tests. The PMSST may also elect to participate in system integration and pre-revenue testing activities where the safety and security of passengers and/or employees may be affected. The PMSST assists in (or at a minimum) reviews the development of integrated test plans and procedures for system verification and demonstration. The assistance and/or review is for both acceptance and system-level tests for safety and security features such as sprinkler systems, alarms, emergency management panels, fire management panels, PA systems, and CCTV.

Those tests identified as being required for safety- and security-related elements, as well as walk-through inspections, will be part of the SSC process. Prior to the testing, safety-related test procedures are reviewed by the PMSST and designated safety representatives may witness safety-related tests. The results of all safety-related tests will be reviewed by the PMSST to determine satisfactory performance based on pre-established pass/fail criteria, safety features, and adherence to the approved test procedures.

CTDOT specified tests might include integrated and pre-operational demonstration tests. The majority of these tests are typically incorporated in the contract documents, which are contained in the CIL. However, if there is an extensive list of non-contract specific integrated tests to be performed, they may be entered on a checklist for tracking purposes.

The integrated tests are developed to verify the integration and compatibility of equipment, facilities, and operation/maintenance procedures to function together under normal, abnormal, and emergency situations. This includes verifying the coordination, response, environmental constraints, and capabilities of CTDOT and external agencies.

The Program Director, or a designated party, is responsible for the development and implementation of the integrated and pre-revenue test demonstration procedures along with documenting and logging all safety-related tests performed. Copies of all applicable test and inspection reports will become part of the formal project files. Testing of fire/life safety and other safety-related test procedures are coordinated with the jurisdictional fire marshal.
Prior to conducting an integrated test, a number of safety and security specification conformance requirements and issues will have been completed. Requirements and issues will depend on the type and nature of the test. A test plan must be developed and approved by the Project Managers prior to initiation of the tests. The PM, PMCS and PMSST should be included in the review process for the test plan.

The test plan and results will become part of the SSC documentation package.

The PMSST participates (as required) in all major contractor and manufacturer audits, inspections, and tests where the safety and security of customers and/or employees, equipment, or facilities could be affected by the improper or incorrect construction or manufacture of system elements. These audits, inspections, and tests cover both facilities and system elements. Included are: First Article Inspections, Mockup Reviews, Qualification Tests, Performance Tests, and Acceptance Tests.

### 7.6 Risk Resolution Verification:

The SSCRC reviews and approves the resolution of each hazard on the PHA, which is maintained and updated through all phases of the project. There is a preliminary hazard assessment made when the hazard is added to the PHA. A final hazard assessment is made once the SSCRC approved design and/or procedural resolution is implemented and the effectiveness of the resolution is verified. The SSCRC final review of the PHAs and the final hazard assessment assures that the degree of risk has been reduced to a level acceptable to CTfastrak Project management.

The Hazard Analysis Tracking Document is the primary tool used by the SSCRC to identify, track, and resolve hazards. The PMSST will initially prepare this document based on the PHAs. Upon completion of the PHAs, any program stakeholder can provide additional inputs. Hazards and safety concerns from all sources discussed in this section, including other hazard analyses prepared by the contractor or sub-contractors, are included and tracked to closure in the Hazard Analysis Tracking Document.

The PMSST, prior to the initiation of revenue service, will prepare a verification report. This report will include an annotated matrix of all safety critical items listing the status (open/closed) of each item. All open items will include any required mitigation methods and a time period in which the item will be permanently closed. The report will include the system SSC document.

Figure 7-2 (repeat of Figure 4-2 for convenience) presents a comprehensive process for identifying, resolving, and tracking safety hazards throughout all phases of project development activity. Managing hazards through identification, assessment, resolution, acceptance, or tracking is an essential function in design from concept through development. An effective hazard management program also provides a crucial tool for determining the safety impacts of engineering change proposals, construction change
orders, operational equivalent methods of compliance, and the issuance of temporary permits and certificates. All identified hazards related to the design, development, installation, operation, and testing of all critical system elements must be documented and eliminated or controlled in the SSC documentation process. This process verifies the safety of the system prior to revenue operations.

7.7 Operational Readiness Reviews

Pre-revenue demonstration tests will be performed by the CTDOT staff to verify the functional capability and operational readiness prior to revenue service. In addition, walk-through inspections of completed facilities, stations, dedicated bus lanes, and vehicles will be performed to determine that safety, security, and fire/life safety requirements have been incorporated into the construction/installation of the CTfastrak Project.

During the pre-operations phase of the system, the procedures and plans are tested for effectiveness under simulated operating conditions for normal, abnormal, and emergency situations. Verification for these activities will be established by signatures of the appropriate officials or employees on all procedures, rulebooks, and training necessary to support operation and maintenance of the system. The operating and maintenance procedures and plans will be judged as either meeting the verification requirements or being recommended for modification.

A final walk-through inspection of completed facilities and systems will be performed in this step.

Operational readiness includes activities to verify the following:

- applicable operations, maintenance, and emergency rules, procedures, and plans have been developed, reviewed, and implemented;
- manuals showing how to operate and maintain systems, equipment and facilities have been developed, reviewed, approved, and accepted by the project team;
- required safety/security-related training for operations and maintenance personnel has been developed, performed, and successfully completed by all personnel; and
- required emergency training has been developed, performed, and successfully completed by all personnel (including public safety personnel, if appropriate).

As part of the verification process, the training programs and documents that support the applicable certifiable elements are evaluated to determine their adequacy. The SSC process verifies that:

- training is adequate and incorporates information regarding safety
- features of the system for normal, abnormal, and emergency conditions; and
Figure 7-2: Safety Hazard Identification and Risk Acceptance Process

- caution and warning notes have been incorporated into the Operation and Maintenance (O&M) Manuals.

Prior to the start of revenue service, emergency exercises will be performed at selected sites. The drills are certified to verify the adequacy of emergency response plans and procedures and assure that external emergency response personnel are prepared to adequately respond to emergencies in the operating CTfastrak BRT. Emergency drills are developed and conducted to:

- familiarize and train response personnel in emergency procedures;
- evaluate response procedures;
- identify improvements to response procedures before a real emergency occurs; and
- maintain an adequate level of preparation for a possible emergency.
7.8 Final Certification and Verification Report

The CTfastrak Project System Safety and Security Certificate will be issued after all required supporting certification documents are completed and approved by the SSCRC. These documents include the Safety and Security CIL, construction and vehicle procurement submittals, Specification Conformance Checklist, Element Certifications, Interim Operations Permit (if needed), and Certificates of Conformance. These documents (to include the project Safety and Security Certificate and Final Verification Report) are required for the CTfastrak Project SSC. Even though all of the documentation may not be available in time for revenue service, the safety impact of this documentation will be assessed and acceptable equivalencies or operating restrictions will be implemented where unacceptable hazards are identified.

The PMSST will utilize a Specification Conformance Checklist to review safety and security CIL submittals. This review is to ensure that the PM, PMCS and PMC have reviewed and signed the submittals indicating that they are complete, accurate, and in compliance with project specifications. The PMSST will also spot-check these submittals with the specifications on a paragraph level to ensure that the basic submittal information appropriately matches the intent of the specifications. A Specification Conformance Checklist will be produced, signed by the PMSST, and submitted to the SSCRC as supporting documentation for the element(s) certification process.

The safety and security certifiable elements in each construction package will be certified independently once all sub-element submittals are received, reviewed, and signed by the appropriate CTDOT staff and verified by the PMSST.

The procurement of buses that will operate on the CTfastrak BRT will be done by CTDOT through the exercise of options on existing contracts, which have followed a process to address safety and security requirements. The CTfastrak Project has been designed to accommodate the potential vehicles that will operate on it. A review of the PHA and TVA process has been conducted to identify any vehicle-related countermeasure recommendations. The only results found relate to the Intelligent Transportation System (ITS) contact, which includes some components that will be installed on vehicles operating on the CTfastrak BRT. They will be subject to the project’s SSC process in their design, installation and integrated testing. Otherwise, the transit buses that will be procured by CTDOT to operate on the CTfastrak BRT exhibit no unique hazards or vulnerabilities that need to receive special attention as part of this project.

Any “Open Items” that remain in effect with operational restrictions will be documented and attached to the elements certificate. The restriction(s) must have been resolved (or replaced by acceptable alternative methods or by having operating restrictions put in place) and approved by the SSCRC.
Each construction package will be issued a Certificate of Conformance, once all elements and sub-elements are certified as described above.

Any “Open Items” that remain in effect with operational restrictions will be documented and attached to the Certificates of Conformance. The restriction(s) must have been resolved (or acceptable equivalencies or operating restrictions put in place) and approved by the SSCRC.

The CTfastrak Project System Safety and Security Certificate will be prepared and issued by the SSCRC once all of the construction packages and vehicle procurements have Certificates of Conformance. This overall project certificate and cover letter will be presented to the CTfastrak Program Director for signature. The certificate’s signature provides a formal notification that the applicable portion of the operating system is safe and secure for revenue service.

Any “Open Items” that remain in effect with operational restrictions will be documented and attached to the System Safety and Security Certificate. These restriction(s) must have been resolved (or acceptable equivalent methods, or operating restrictions put in place) and approved by the SSCRC.

The PMSST, prior to the initiation of revenue service, will prepare a verification report. This report will include an annotated matrix of all safety critical items listing the status (open/closed) of each item. All open items will include any required mitigation methods and a time period in which the item will be permanently closed. The report will include the System SSC document.

A documentation file system is a requirement for the SSC Project. The Project Managers control program documents through coordination with the CTfastrak Project configuration management program. The project management document control staff is responsible for controlling and maintaining the certification document file system. The project documentation will be maintained for the life of the CTfastrak Project system. All documentation submitted to the project file system must be:

- identified by certifiable element;
- completed as prescribed by the certification process;
- maintained in a secured environment; and
- accessible to the SSCRC.

The document file is to contain original documents pertaining to the SSC process, permits, reports, committee minutes, open items lists, certificates, and documentation that support all resolutions to exceptions and open items. All relevant documents to be provided by the responsible design/ construction manager are to be done in a timely manner to ensure that each certifiable element is certified prior to use. The release of project forms, records, or other types of documentation to the project document file will not delay the issuance of permits, certificates, or periodic reports. Periodic reviews and
inspections of the SSC files will be performed by the PMSST. These will ensure that the
documentation to support the certificates are in place, along with other documentation
such as analyses, permits, reports, catalogs, manuals and minutes of meetings.
8 Construction Safety and Security Program

The CTfastrak Construction Safety and Security Program has been developed in accordance with applicable (applicability of regulations is determined by CTfastrak Project Management) Federal, State, and Local regulatory requirements, and is encompassed within this section of the SSMP. Specific Federal regulations include:

- 29 CFR Part 1910, Occupational Safety and Health Standards (General Industry);
- 29 CFR Part 1926, Safety and Health Regulations for Construction;
- 49 CFR Part 214, Railroad Workplace Safety;
- 49 CFR Part 217, Railroad Operating Rules;
- 49 CFR Part 219, Control of Alcohol and Drug Use; and

It is the responsibility of the CTfastrak Project Management to require that all Contractors meet the requirements of this program and adhere to all applicable Federal, State, and Local codes, safety standards, regulations, CTDOT procedures and industry practices.

Each Contractor shall be required to develop and submit a Construction Safety and Security Plan (CSSP) to CTfastrak Project Management for review and approval as part of the Contract submittal process. It shall be the responsibility of the Contractor and its employees to abide by the terms of the Contract and its CSSP.

Job-site safety and conformance with OSHA, DOT, FTA and FRA and state and local codes and regulations shall be the responsibility of the Contractor performing the work. The Contractor’s safety representative shall be the contact for discussions on construction safety and security matters including issues of non-conformance with project and regulatory requirements. To ensure these requirements are met, it is this project’s policy that Contractor personnel who do not conform to safety and security requirements be considered unqualified to perform the contracted services or work and as such, shall be denied site access. Contractors who fail to control personnel actions regarding safety and security shall have their contract terminated. If CTfastrak Project Management determines that the Contractor or its Subcontractor is not conforming with the applicable safety and security requirements, they shall take appropriate measures in accordance with the CTDOT Construction Manual and the contract.

CTfastrak Project Management reserves the right to require the Contractor to modify, at any time, any portion of its CSSP that is not in conformance with Federal, State, or Local codes and regulations, or with the program’s safety policies and procedures. All
Contractor supervisors, when notified of an unsafe or hazardous situation, condition, or practice are obligated to take the appropriate response. No Contractor, employee or other person involved with or supporting this program shall have their safety and security compromised through intimidation or fear of reprisal for reporting any of the aforementioned items.

The CTDOT Construction Manual, Vol. 1 Section 1-107, Safety, states that:

The Contractor is required to perform all work in accordance with the applicable safety regulations and further to take all precautions that the Engineer may deem necessary and reasonable for the protection of traveling public, all people on the project (including employees of the Contractor and CTDOT as well as private citizens), and for the protection of property. Construction sites can be dangerous to anyone if proper precautions are not taken. Care must be taken at all times to ensure the project sites and work zones are safe and passable. Special protective measures are required when working at night, in heavy traffic, at extreme heights or depths, in confined spaces, near hazardous or contaminated materials, during blasting operations, near or over water, near railroad tracks or in the vicinity of live electrical wires. Inspectors should refer to the project specifications and/or their Project Engineer for advice and guidance. When an unsafe practice or condition exists which presents an imminent danger to the safety of the traveling public or persons on site, the Inspector will request the Contractor to correct the situation. If the Contractor does not correct the unsafe practice or condition, the Chief Inspector should order the Contractor in writing to stop the operation that has been deemed unsafe, and notify the Assistant District Engineer as soon as possible. If the Assistant District Engineer's involvement cannot correct the situation, the District Engineer and the Office of Construction will be notified.

All Contractor work activities will be coordinated with CTfastrak PMC prior to their commencement. All Contractor operations that may have an impact on, or which may be impacted by rail operations shall be coordinated with the affected railroads prior to the commencement of work.

The CTfastrak PMC must be notified immediately of any unsafe conditions which result in the issuance of a stop work order.

8.1 Safety and Security Responsibilities of the CTfastrak Project Organization
The CTfastrak PMC (or designee) is responsible for implementation and oversight of this Program, including the following:

- reviewing and approving the Contractors’ CSSPs and documenting any disparities with the CTDOT Construction Manual and this CTfastrak Construction Safety and Security Program;
- performing oversight activities related to Contractor safety and security, including documentation and record keeping;
- monitoring Contractors’ conformance to submitted plans and report areas of non-conformance;
- performing site audits to assure that the Contractors are meeting obligations and responsibilities pertaining to maintaining a safe and secure worksite;
- ensuring that the Contractors implement required corrective action and monitor its effects; and
- gathering reporting information for submission to the CTfastrak Project Management as necessary.

If contract security services are used to protect the work sites, security criteria must be included in all bid and contract documents, security criteria must be included in all bid and contract documents and fully describe the expectations and requirements for securing the site(s). Among the items that should be specified is that the contract security firm:

- meet all applicable Federal, State, and Local environmental, health, and safety regulations and submit in writing a comprehensive safety and health plan for all specific aspects of the contract;
- provide all its employees the necessary training, medical exams, and safety equipment required by the job specifications; and
- submit a written site-specific safety and security plan for each worksite that is part of the project covered by the contract.

### 8.2 Recommended Elements of a Construction Safety and Security Plan

During construction, both FTA and the CTfastrak Project have a vested interest in the establishment of programs addressing safety, risk management, and insurance. Careful consideration of these elements will help guard against construction delays, serious
injury, extensive costs, and liability considerations that frequently arise in fixed guideway and other transit projects.

The CTfastrak Project requires its construction contractors to prepare CSSPs. The CSSP should be formulated based on the following assumptions:

- Contractor management and supervision are charged with the responsibility of preventing the occurrence of incidents or conditions that could lead to occupational injuries or illnesses.
- Safety and security should never be sacrificed for production and should be considered to be an integral part of project risk management, quality control, cost reduction, and job efficiency.
- A good safety and security record reflects the quality of management, supervision, and the work force.
- The established policy should be to accomplish the work in the safest and most secure possible manner consistent with good work practices. Contractor management at every level should be charged with the task of translating this policy into positive actions.
- Contractors with a good safety and security record on prior projects tend to maintain a good record and run a safe, secure, and efficient job on new work. Consequently, a contractor's safety and security performance track record on prior work should be a factor in qualifying bidders.
- The program should establish management safety and security policies and procedures and be in compliance with all applicable Federal, State and Local safety, security and health regulations and standards. In case of a conflict between standards or regulations, the stricter requirement should apply.

There are a number of approaches that may be taken to the management of safety and security during construction; all require that safety and security awareness exist at all levels of the construction organization so that all employees on and off the site are aware of the importance of safety and security.

The Contractor's CSSP should include information on how they will plan its safety and security program. The CSSP should be simple to follow and implement. The CSSP should be in conformance with the specifications, applicable laws, codes, rules, and regulations and the adequacy of coverage.

The CSSP should list the name and/or title of the individual responsible for implementing the CSSP, the scope of his/her authority, and the title of the person to
whom he/she reports. The CSSP should address the following (as applicable to the Contract work):

- construction safety and health guidelines promulgation and execution responsibility, including job site inspection responsibility, job site first aid medical treatment responsibility, and emergency first aid program;
- safety education of new employees for general safety regulations and specifically for accident prevention;
- proposed “Tool Box” safety meeting program;
- job site inspections, including scope and frequency;
- policies pertaining to employee hazard assessments and personal protective equipment (PPE) that are required (i.e., hard hats, eye and face protection, safety harnesses, foot protection, respiratory protection, hearing protection, hand protection) and specification of other devices that are available (i.e., wet weather gear and protective gear required for specialized tasks);
- safety devices required and available, including local ventilation and exhaust equipment, warning horns, lockout devices, noise meters, light meters, oxygen detectors, hazardous gas and vapor detectors;
- protection of the public, including pedestrian control, traffic control, and protective devices available such as barricades, cones, lights, and warnings;
- accident investigation procedures, including details of job site medical facilities, doctor/hospital arrangements, and emergency and non-emergency policies; availability of job-site accident response and rescue equipment; and policies for accident investigation and paperwork handling;
- policies for subcontractor safety, including responsibility for subcontractor safety, inclusion of safety plan requirements in subcontracts, and specific requirements of subcontractor to promote safety and health awareness;
- adverse weather plans;
- other safety and health features, including site conditions/security, housekeeping procedures, parking facilities for employees, restrooms and changing rooms for employees; and
- provisions for implementation, approval, and modification of the CSSP.
If the construction project involves more than one work site, a site-specific plan should also address the following topics specific to each site (as applicable to the Contract work):

- General safety and health provisions
- Occupational health, industrial hygiene and environmental contracts
- Recordkeeping
- Bloodborne pathogens
- Hearing conservation
- Drug and alcohol testing
- Ergonomics
- Machine safeguarding
- Personal protective and lifesaving equipment
- Signs, signals, barricades and traffic control
- Materials handling
- Walking/working surfaces
- Tools (hand and power)
- Welding and cutting
- Flammable and Combustible gases and liquids
- Fire Protection
- Lockout/Tagout
- Electrical
- Ladders and scaffolding
- Floor and wall openings and stairways
- Cranes, derricks, hoists, elevators, pile drivers and conveyors elevated work platforms, aerial lifts
- Excavation, trenching and shoring
- Shafts and caissons
- Confined Space entry
- Demolition, including asbestos and lead remediation
- Blasting and the use of explosives
- Rollover protective structures, overheads, protection, reverse warning alarms
- Hazard Communication, hazardous materials and Material Safety Data Sheets
- Release of toxic and hazardous substances into the environment

The following security elements should be included in the CSSP (As applicable to the Contract work):

- purpose, mission and objectives of the plan, including identification of the manager and site safety/security officer(s), scope of their responsibilities, how they will be kept aware of issues, and how system managers will be able to contact them regularly, during non-business hours, or during an emergency situation;
plans for site security, including inventory and placement of physical security systems (i.e., intrusion detection, fencing, barriers, lighting, CCTV);

plans for human security (guard patrols, visitor access control points, roving patrols), to include hours of work and explanation of coverage during working hours and non-working hours, including the location of any fixed posts and the hours those posts are to be staffed and the routes of any walking posts and the security checks that are to be made along those routes;

plans for identifying specific hazards or risks and mitigation strategies, including the methods for investigating and reporting incidents and accidents, including who is responsible for investigation and reporting and to whom reports will be circulated;

access control and control of non-public areas, including securing the construction site field office(s);

emergency procedures for such events as fire, earthquake, flood, chemical spills, and accidents with injuries, including review of decontamination methods/procedures; who is trained, what equipment is available, and how incidents will be reported to appropriate oversight and regulatory agencies;

communications capabilities (landline and cell phones, beepers, portable-two way radios);

local emergency and medical addresses/phone numbers (including all fire/police and hospitals that might respond to the site);

whether personal protective equipment is required for any specific job activity; whether it has been provided and whether employees are trained in its use;

locks and key control to be used during construction;

inspection of and deliveries of goods and equipment, including the inspection procedures for delivery/departure of equipment, and personal vehicles;

document control procedures to include handling of blueprints, public utility drawings, transit system diagrams, and other security-sensitive documents that may be filed at the site;

personnel identification systems and policies (ID badges, cards, etc.) including policies on background investigations if required and any sign in/sign out policies;

security awareness training;
8.3 Personal Protective Equipment

The CSSP and the aforementioned Federal regulations encompass requirements for the hazard assessment, provision, training, use, and maintenance of personal protective equipment (PPE). At a minimum, all employee and contractor personnel performing work in support of the CTfastrak Project are required to meet the PPE requirements of 49 CFR Part 214 and wear hard hats, steel-toed shoes, safety glasses, and approved fluorescent safety vests (note: vests shall be of the style/type required by and shall be worn in compliance with CTDOT and railroad requirements).

The Contractor shall conduct reviews of safety and security related rules, procedures and training programs to ensure they are in compliance with applicable Federal and State regulations as well as to ensure that all project contractor personnel have received the appropriate training applicable to their position and possess the knowledge, skills, and abilities necessary for performing their work safely and effectively. This includes the use of PPE.

8.4 Personnel Training Requirements

Project safety training programs, such as those required by 49 CFR Part 214, and 29 CFR Part 1910 and Part 1926 should be incorporated. At a minimum, training of contractor personnel should include:

- on-track worker protection;
- equipment familiarization;
- facility security policies and procedures;
- personal safety, housekeeping and material control procedures;
- hazardous materials handling and employee “Right to Know”;
- emergency response training;
- control of alcohol and drug use; and
- accident/incident investigation and reporting.

All training, testing and certification records, including course outlines and examinations are maintained by the Contractors in a secure location. All contractors shall provide records of the successful completion of all contractually required and regulatory mandated safety training provided to their personnel, prior to its employees being assigned work on the CTfastrak Project. All proposed changes to established safety rules, procedures, policies, practices, and training must be submitted to the CTfastrak Project Management for safety and security review and approval.
It is CTfastrak Project policy to require that all Contractors are instructed on, know and follow the appropriate safety procedures while performing work on the property. All Contractors must therefore comply with all applicable rules, regulations, and requirements of OSHA (including CFR Parts 1910 and 1926), CTDOT, FRA, and FTA, as well as all other Federal, State, and Local regulations.

8.5 On-Track Safety
The CTfastrak Project has established agreements with the existing operating railroads present in the CTfastrak corridor to coordinate track access and work activities. Depending on the work location, rail traffic, and other situational parameters, the methods for achieving on-track safety will vary. All methods however must comply with the requirements of 49 CFR Part 214 and Amtrak’s Contractor Safety and Security Training.

8.6 Contractor Training Requirements
It is the responsibility of all Contractors of the project to establish written safety orientation and training programs that provide their employees with the information required to safely execute their duties under the scope of their respective Contracts. The training programs should address employee responsibilities at all levels.

All employees trained and certified as railroad workers must successfully complete Railroad Worker Protection training annually as required by 49 CFR Part 214. Records of all training must be maintained by the Contractor and made available for review by CTfastrak Project Management upon request.

8.7 First Aid
Adequate first aid supplies must be provided by the Contractor and be on-site at all times. The supplies must be easily accessible to all employees for immediate use. Written procedures must also be developed and implemented by the Contractor to ensure that all first aid supplies are replaced promptly if used, and are not missing or depleted. In addition, each contractor of the CTfastrak Project is responsible for ensuring that sufficient personnel having valid and verifiable CPR and First Aid certification (received in accordance with the American Red Cross, or an equivalent training program) are made available at the work site(s) to render first aid during all hours of work.

8.8 Hazardous Materials Program
The objective of the hazardous materials program is to ensure that all human beings
and the environment are provided with adequate safeguards from injury/illness and environmental destruction that could result from the improper use, storage, disposal or contact with hazardous materials. As part of the program, all Contractors of the project receiving, storing, handling or using hazardous materials at construction sites, must have and properly administer their hazardous materials program.

It is the responsibility of the Contractor to assess which environmental and occupational safety requirements are applicable to its operation and to create a hazardous materials program outlining the management process and procedures to be administered by the Contractor to meet or exceed Federal, State and Local requirements. At a minimum, the Contractor’s hazardous materials program must contain procedures for reporting and responding to hazardous material spills, releases, and other accidents/incidents.

Hazardous materials incidents occurring on or adjacent to the rail corridor must be immediately reported to railroad area supervision. It is the responsibility of area supervision to notify the appropriate emergency response agencies, including:

- appropriate railroad control center;
- fire and police departments;
- emergency medical response service;
- Environmental Protection Agency (EPA); Connecticut Department of Energy and Environmental Protection CTDEEP
- public works department;
- sanitation department;
- utility companies - gas, electricity, telephone;
- water department;
- CTDOT; and
- Chemical Transportation Emergency Center (CHEMTREC).

8.9 Contractor Drug and Alcohol Programs

It is CTDOT’s policy that the use of drugs and alcohol are strictly prohibited on all project properties. Contractors and any and all Subcontractors are responsible for implementing and maintaining their own effective Substance Abuse Program. The Substance Abuse Program will be subject to review by CTfastrak Project Management.

8.10 Safety Audits of Contractor Work Sites

It is the responsibility of the CTfastrak PMC (or designee) to conduct periodic audits to ensure safety and security rules and procedures are being followed and to identify potential hazards and unsafe work conditions or practices. The audits are also performed to enhance hazard detection and safety awareness among personnel and to assist in eliminating, mitigating or controlling identified hazards prior to their resulting in
an accident/incident.

The Contractors should be audited on a regular basis, including some without advanced notice to assure that safety and security requirements are being met at all times, not only at times of pre-arranged audits.

Factors used to determine the frequency and scope of on-site audits should include the following: the duration of the specific construction project; the time elapses since the last audit; the level of vulnerability to safety and security violations or criminal activity to the workforce and/or the property; and previous experience with the Contractor and/or Subcontractor.

The scope of the audits should ensure that the Contractors’ practices comply with the relevant aspects of their CSSP and the Contract requirements. Deficiencies detected during the audits shall be conveyed to the Contractor for correction.

8.11 Accident/Incident Reporting

It is the responsibility of the CTfastrak Project PMC (or designee) to implement CTDOT’s Accident/Incident Reporting Policy and associated procedures applicable to the project, for which the Contractor is responsible for following. Should an accident/incident occur during the construction or testing phases of the Project, immediate and full care of any injured party is first priority. The following agencies and individuals are immediately and concurrently (if possible) notified by the responsible Contractor:

- Applicable emergency response units:
  - Emergency Medical Services
  - State and Local Police
  - Fire Department
  - Other Emergency Response Agencies

- Applicable CTfastrak Project personnel:
  - Project Manager, Construction
  - Construction Management Contractor
  - Other individuals as directed by the PMC

8.12 Emergency Preparedness, Planning, and Training

An Emergency Preparedness Plan (EPP) and specific Emergency Operating Procedures (EOPs) will be developed by the Contractor during construction phase.
These plans and procedures will establish, in detail, the roles and responsibilities carried out by Contractor personnel and various emergency response agencies.

During an emergency or disaster involving the CTfastrak Project, properties, personnel, and/or passengers, all personnel located at the scene of the emergency will first be under the authority of the On-Site Emergency Agency Representative or Incident Commander (i.e., Fire Chief, Police, Emergency Medical Services, etc.) and then under the authority of his/her applicable manager or supervisor. Emergency response and lifesaving efforts are the sole responsibility of trained emergency response personnel.
9 49 CFR Part 659 Requirements

Not Applicable. These regulations apply only to rail fixed guideway systems.
10 Federal Railroad Administration (FRA) Coordination

CTDOT has been coordinating with Amtrak on the required agreements to use the railroad right-of-way by the CTfastrak Project. Any coordination with the FRA has been accomplished by Amtrak, but CTDOT will be maintaining an interface with the FRA to assure that all of their requirements for the CTfastrak Project are being appropriately addressed.

Both FRA and Amtrak have been invited to participate in the recently reconstituted SSCRC as non-voting members.
11 Department of Homeland Security (DHS) Coordination

CTDOT has been coordinating with the Connecticut Field Office of the DHS Transportation Security Administration (TSA) for the CTfastrak Project. They have participated in SSCRC meetings as a non-voting member to advise on security issues, a role they have also been doing with CTTransit. They will continue to be invited to all future SSCRC meetings.
Appendix A
SSMP Definitions
Acceptance Tests: Procedures designed to evaluate correct performance of that subsystem’s components in a static environment. These tests are usually performed prior to integrated testing.

Baseline Documents: Drawings, specifications, standards, design criteria, definitions, and program plans which define the project form, fit, and functional requirements, as well as any other contract and management document designated as subject to documentation controls.

Closed-loop: The principle of system safety feedback in which the response of validated safety data inputs into the system are compared with original assumptions and analyses and feedback into design, construction, procurement, and operations to provide “lessons learned” into active processes.

Component: Item, or group of items, in system or sub-system that perform a single function.

Configuration Management: Formal process instituted to control the documentation of the design, evaluation, acceptance, operation and maintenance of a project.

Configuration Management Log Sheet: Record of all activities pertaining to deviation requests for baseline documents.

Contractor: A private sector enterprise engaged to provide services or products within agreed limits specified by a procuring activity.

Corrective action: A documented design, process, procedure, or materials change implemented and validated to correct the cause of failure or design deficiency.

Criticality: A relative measure of the consequences of a failure mode or hazard and its frequency of occurrences.

Design Review Package: The project design documents issued for review at a specified design stage.

Detection mechanism: The means or methods by which a failure can be discovered by an operator under normal system operation or can be discovered by the maintenance crew by some diagnostic action.

Deviation Request: Request to deviate from the established design, procedural baseline, final schedule, or other baseline item.
Emergency: A situation which is life threatening to passengers, employees, or other interested citizens or which causes damage to any transit vehicle or facility or results in the significant theft of services and reduces the ability of the system to fulfill its mission.

Environment: The conditions, circumstances, influences, stresses and combinations thereof, surrounding and affecting systems or equipment during storage, handling, transportation, testing, installation, and use in operation.

Failure: An inability to perform an intended function within prescribed limits.

Failure mode and effects analysis (FMEA): A procedure by which each potential failure mode in a system is analyzed to determine the results or effects thereof on the system and to classify each potential failure mode according to its severity.

Fault Tree Analysis: A deductive analysis procedure which graphically presents undesired events to determine possible causes of that event.

Final Design Package: The series of documents and documentation that represent and support the final design review and completion and which become part of the bid package.

Hazard: Any real or potential condition that can cause injury, death, or damage to or loss of equipment or property.

Hazard Analysis: Any analysis performed to identify hazardous conditions for the purpose of their elimination or control. Hazard analysis is done to identify safety problems and possible solutions and present options to decision makers.

Hazard Cause: A condition that contributes to a hazard. It could be unsafe design, environmental factors, failure, human error, etc.

Hazard Controls: Measures that eliminate a hazard or reduce the severity or probability of its potential effect.

Hazard Probability: The probability that a hazard will occur during the planned life of a system. Hazard probability may be expressed in quantitative or qualitative terms.

Hazard Severity: An assessment of the worst credible impact that could be caused by a specific hazard.

Hazard Resolution: The analysis and subsequent action taken to reduce, to the lowest level practical, the risk associated with an identified hazard.
Integration Test: A test performed to demonstrate that a system or systems function satisfactorily when connected to interfacing systems.

Interface: The junction points within or between systems or subsystems where matching or accommodation must be properly achieved in order to make their operation compatible with the successful operation of all other functional entities.

Malfunction: Any anomaly or failure wherein the system, subsystem, or component fails to function as intended.

Operating Hazard Analysis (OHA): Identifies and evaluates hazards resulting from the implementation of operations or tasks performed by persons, considering: operation, test, maintenance, repair, transportation, handling, equipment, or removal of the system.

Preliminary Hazard Analysis (PHA): An inductive analysis performed to obtain an initial risk assessment of a concept or system.

Redundancy: The existence in a system of more than one means of accomplishing a given function.

Reliability: The chance that an item can perform its required function for a specified time under specified conditions.

Resolution: Changes that are made in the system or subsystem design, procedures, or activities which eliminate or control the identified hazard to an acceptable level.

Revenue Service: The transportation of fare-paying passengers.

Risk. An expression of possible loss over a specific period of time or number of operational cycles. It may be indicated in terms of hazard severity and probability.

Risk (residual): The risk remaining after hazard controls have been applied.

Safety Certification. The process of verifying that safety-related requirements are incorporated into a transit system, thereby demonstrating that it is operationally ready for revenue service and safe for passengers, employees, emergency responders, and the general public.

Safety Critical Items List (CIL): The listing of Category I (Catastrophic), and Category II (Critical), hazards. This list is usually compiled from all hazards identified in analysis and hazards identified from sources other than analysis. It is used to track resolution of all identified hazards.
**Safety Design Criteria:** An organized listing of safety codes, regulations, rules, design procedures, standards, recommended practices, handbooks and manuals prepared to provide guidance to project designers in the development of technical specifications that meet minimum safety parameters.

**Safety Requirements:** The specification of safety design criteria into the technical documents and drawings that comprise the detailed designs, procedures, plans and processes required to deliver the project.

**Security:** Freedom from intentional danger

**Security Breach:** An unforeseen event or occurrence which endangers life or property and may result in the loss of services or system equipment.

**Security Incident:** An unforeseen event or occurrence which does not necessarily result in death, injury, or significant property damage but may result in minor loss of revenue.

**Security Threat:** Any source that may result in a security breach, such as vandal or disgruntled employee; or an activity, such as an assault, intrusion, fire, etc.

**Severity:** The consequences of a failure mode. Severity considers the worst potential consequence of a failure, determined by the degree of injury, property damage, or system damage that could ultimately occur.

**Single failure point:** The failure of an item which would result in failure of the system and is not compensated for by redundancy or alternative operational procedure.

**Subsystem:** An element of a system that, in itself may constitute a system.

**System:** A composite of people (employees, passengers, others), property (facilities and equipment), environment (physical, social, institutional), and procedures (standard operating, emergency operating, and training) which are integrated to perform a specific operational function in a specific environment.

**System Safety:** The application of engineering and management principles, criteria, and techniques to optimize safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle.

**System Safety Engineering:** An engineering discipline requiring specialized professional knowledge and skills in applying scientific and engineering principles, criteria, and techniques to identify and eliminate hazards, or reduce the risk associated with hazards.
System Safety Management: An element of management that defines the system safety program requirements and ensures the planning, implementation and accomplishment of system safety tasks and activities consistent with the overall program requirements.

System Safety Program: The combined tasks and activities of system safety management and system safety engineering that enhance operational effectiveness by satisfying the system safety requirements in a timely, cost-effective manner throughout all phases of the system life cycle.

System Safety Program Plan: A description of the planned methods to be used by the contractor to implement the tailored requirements of this standard, including organizational responsibilities, resources, methods of accomplishment, milestones, depth of effort, and integration with other program engineering and management activities and related systems.

System Security: The application of operating, technical, and management techniques and principles to the security aspects of a system throughout its life to reduce threats and vulnerabilities to the most practical level through the most effective use of available resources.

System Security Management: An element of management that defines the system security requirements and ensures the planning, implementation, and accomplishments of system security tasks and activities.

System Security Program: The combined tasks and activities of system security management and system security analysis that enhance operational effectiveness by satisfying the security requirements in a timely and cost-effective manner throughout all phases of a system life cycle.

Threat: Any real or potential condition that can cause injury or death to passengers or employees or damage to or loss of transit equipment, property, and/or facilities.

Threat Analysis: A systematic analysis of a system operation performed to identify threats and make recommendations for their elimination or mitigation during all revenue and non-revenue operation.

Threat Probability: The probability a threat will occur during the plan’s life. Threat probability may be expressed in quantitative or qualitative terms. An example of a threat-probability ranking system is as follows: (a) frequent, (b) probable, (c) occasional, (d) remote, (e) improbable, and (f) impossible.

Threat Resolution: The analysis and subsequent action taken to reduce the risks associated with an identified threat to the lowest practical level.
**Threat Severity:** A qualitative measure of the worst possible consequences of a specific threat:

**Unsafe Condition or Act:** Any condition or act which endangers life or property.

**Vulnerability:** Characteristics of passengers, employees, vehicles, and/or facilities which increase the probability of a security breach

**Verification:** Documented conformance, demonstrated through testing, inspection, or other means, that the designed or delivered project, system, subsystem, or item ensuring the accuracy or correctness in comparison with a safety requirement.