FEDERAL TRANSIT ADMINISTRATION

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6. AUTHOR(S)* Kam Shadan, lead author for this update, with support William Plumpton (Gannett Fleming), Michael Eidlin (Kal Krishnan Consulting Services), David Sillars (Sillars), Paul Krogh (K2 Construction Consultants), Dain Pankratz (Boyd Caton & Grant), and Robin Hazy (Raul V. Bravo + Associates)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Gannett Fleming, Inc.
San Bruno Office Park
881 Sneath Lane, Suite 210
San Bruno, California 94066

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Department of Transportation
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1200 New Jersey Avenue, S.E.
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11. SUPPLEMENTARY NOTES * Assisted by: Lee Hamre (H.C. Peck & Associates), and Kate Berrigan (Gannett Fleming)

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13. ABSTRACT (Maximum 200 words) This update of the document published in September 1990 and updated in June 1996, May 2003, and July 2011 reflects FTA project development, grants, and project management requirements. It incorporates the experience of FTA's Project Management Oversight Program research and technical assistance initiatives, and new or updated Circulars and legislation, including changes due to the Moving Ahead for Progress in the 21st Century Act. Additional guidance is provided on safety and security considerations and certification process, project risk assessment and allocation, project controls, project delivery approaches, financing, real estate acquisition, dispute resolution, quality assurance/quality control, value engineering, public communications, and identifies additional sources of guidance, training, and assistance.

The Guidelines describe the transit capital project development process, general project management principles, and the application of those principles in the planning, design, construction/equipment procurement, and testing/start-up phases. While emphasizing Major Capital Projects and New Starts projects, information on the Small Starts program is also provided. Regardless, the principles and practice discussed have applicability to any capital transit project.

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Throughout this update, FTA's Dale Wegner provided direction on content modifications. Selected FTA subject matter experts were asked to review various sections of the initial draft of the ***Guidelines*** and offer comments, and did so to varying degree with comments taken into consideration.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

A&E	Architect(ure) and Engineer(ing)
AA	Alternatives Analysis
AACE	Association for the Advancement of Cost Engineering International
AAR	Association of American Railroads
ADA	Americans with Disabilities Act
AGT	Automated Guideway Transit
AIT	Arts-in-Transit
AP	Acquisition Plan
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ATC	Alternative Technical Concept
BAFO	Best and Final Offer
BFMP	Bus Fleet Management Plan
BOO	Build-Own-Operate
BOT	Build-Operate-Transfer
BRT	Bus Rapid Transit
BTO	Build-Transfer-Operate
CADD	Computer Assisted Design and Drafting
CBTC	Communications Based Train Control
CCB	Change Control Board
CCT	Community Coordination Team
CCTV	Closed Circuit Television
CE	Categorical Exclusion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulation
CII	Construction Industry Institute
CIG	Capital Investment Grant
CIL	Certifiable Items List
CM	Construction Manager/Management
CMAA	Construction Management Association of America
CMAQ	Congestion Mitigation and Air Quality
CM/GC	Construction Manager/General Contractor
CMR	Construction Manager At Risk
CPM	Critical Path Method
CPTED	Crime Prevention Through Environmental Design
CSI	Construction Specifications Institute
CSSM	Construction Safety and Security Manual
CSSP	Contractor Safety and Security Plan
CURT	Construction Users Roundtable
CVS	Certified Value Specialist
D/B	Design/Build
D/B/B	Design/Bid/Build
DBE	Disadvantaged Business Enterprise
DBIA	Design Build Institute of America
D/B/O/M	Design/Build/Operate/Maintain
DBOM/F	Design Build Operate Maintain/Finance
DEIS	Draft Environmental Impact Statement
DHS	Department of Homeland Security
DTM	Digital Terrain Model
DOT	Department of Transportation
DRB	Dispute Review Board
EA	Environmental Assessment

EEO	Equal Employment Opportunity
EIS	Environmental Impact Statement
EJ	Environmental Justice
EMI	Electromagnetic Interference
EPA	Environmental Protection Agency
ESA	Environmental Site Assessment
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulations
FARA	Federal Acquisition Reform Act
FFGA	Full Funding Grant Agreement
FHWA	Federal Highway Administration
FLSC	Fire-Life Safety Committee
FMCSS	Federal Motor Carrier Safety Standards
FMO	Financial Management Oversight
FMP	Fleet Management Plan
FMVSS	Federal Motor Vehicle Safety Standards
FONSI	Finding of No Significant Impact
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GAN	Grant Anticipation Note
GBR	Geotechnical Baseline Report
GDR	Geotechnical Data Report
GEC	General Engineering Consultant
GIR	Geotechnical Interpretive Report
GMD	Geotechnical Memorandum for Design
GMP	Guaranteed Maximum Price
GPP	Geotechnical Program Plan
HAR	Hazard Assessment and Resolution
HOV	High Occupancy Vehicle
HUD	Department of Housing and Urban Development
HVAC	Heating Ventilation and Air Conditioning
IMPS	Integrated Master Project Schedule
ISO	International Organization for Standardization
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITP	Integrated Test Plan
ITS	Intelligent Transportation Systems
LONP	Letter of No Prejudice
LPA	Locally Preferred Alternative
LRT	Light Rail Transit
LUC	Local User Council
MAP-21	Moving Ahead for Progress in the 21st Century (Public Law 112-141)
MCP	Major Capital Project
MDBF	Mean Distance Between Failures
MIS	Major Investment Study
MOW	Maintenance of Way
MP	Monitoring Procedures for FRA
MPO	Metropolitan Planning Organization
NAA	Non-Attainment Area
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPRM	Notice of Proposed Rulemaking
NS	New Start
NTD	National Transit Database
NTI	National Transit Institute
NTP	Notice to Proceed
NS	New Starts

OBS	Organization Breakdown Structure
O&M	Operating (ion) and Maintenance
OBS	Organizational Breakdown Structure
OCIP	Owner Controlled Insurance Program or Plan
OGT	Office of Grants and Training
OLI	Operation Lifesaver, Inc.
OSHA	Occupational Safety and Health Administration
OSR	Operating Spares Ratio
PCGA	Project Construction Grant Agreement
PDM	Precedence Diagram Method
PD	Project Development
PERT	Program Evaluation and Review Technique
PHA	Preliminary Hazard Analysis
PLA	Project Labor Agreement
PM	Project/Program Manager/Management
PMI	Project Management Institute
PMO	Project Management Oversight
PMOC	Project Management Oversight Contractor
PMP	Project Management Plan
PRO	Pre-Revenue Operations
PTC	Positive Train Control
PTMS	Public Transportation Facilities & Equipment Management System
PVR	Peak Vehicle Requirements
QA	Quality Assurance
QC	Quality Control
RAC	Rail Activation Committee
RAM	Rail Activation Manager
RAMP	Real Estate Acquisition and Management Plan
RAN	Revenue Anticipation Note
RAP	Rail Activation Plan
RCMP	Risk and Contingency Management Plan
RE	Resident Engineer
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Qualifications
RIP	Reliability Improvement Program
ROD	Record of Decision
ROI	Return on Investment
ROW	Right of Way or Rights of Way {also sometimes seen as R/W)
RSD	Revenue Service Date (formerly Revenue Operations Date)
RTP	Regional Transportation Plan
SAVE	Society of American Value Engineers
SBE	Small Business Enterprise
SC	Safety Certification
SCC	Standard Cost Categories
SCORC	System Change and Operations Review Committee
SCP	Situational Crime Prevention
S/DBE	Small/Disadvantaged Business Enterprise
SEPP	System Security and Emergency Preparedness Plan
SIT	System Integration Test
SITC	System Integration Test Committee
SGR	State of Good Repair
SOW	Scope of Work
SSA	Source Selection Authority
SSC	Safety and Security Certification
SSCC	Safety and Security Certification Committee

SSCP	Safety and Security Certification Plan
SSCRC	Safety and Security Certification Review Committee
SSCVR	Safety and Security Certification Verification Review (or Report)
SSGA	Small Starts Grant Agreement
SSMP	Safety and Security Management Plan
SSO	State Safety Oversight
SSOA	State Safety Oversight Agency
SSP	System Security Plan
SSPP	System Safety (and/or Security) Program Plan
SSPS	System Safety Program Standards
SSRR	Safety and Security Readiness Review
STB	Surface Transportation Board
STIP	Statewide Transportation Improvement Program, System Integration Test Plan
STP	Surface Transportation Program
TAM	Transit Asset Management
TCRP	Transit Cooperative Research Program
TDP	Turnkey Demonstration Program
TECP	Tax Exempt Commercial Paper
TIFIA	Transportation Infrastructure Finance and Innovation Act
TIP	Transportation Improvement Program
TOD	Transit-Oriented Development
TPMS	Transit Performance Monitoring System
TrAMS	Transit Award Management System
TQM	Total Quality Management
TSA	Transportation Security Administration
TSI	Transportation Safety Institute
TSM	Transportation System Management
TVA	Threat and Vulnerability Analysis
URA	Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970
USACE	United States Army Corps of Engineers
USC	United States Code
USCG	United States Coast Guard
USPAP	Uniform Standards of Professional Appraisal Practice
VE	Value Engineering
VECP	Value Engineering Change Proposal
WBS	Work Breakdown Structure
WMD	Weapons of Mass Destruction

CHAPTER 1 INTRODUCTION

1.1 Purpose and Scope of the Guidelines

This ***Project and Construction Management Guidelines*** document (hereafter referred to as the ***Guidelines***) has been developed under Federal Transit Administration (FTA) sponsorship to assist those involved in advancing transit capital projects to achieve implementation success in terms of the project scope, function, schedule, cost, safety, and quality.

The ***Guidelines*** were originally published in September 1990 and subsequently updated in June 1996 and again in May 2003 and July 2011. They summarize FTA requirements, best practices, and research results in the management of transit capital project development. The ***Guidelines*** are designed for use by FTA Project Sponsors (also used to mean owner or transit agency) and their consultants, as well as by FTA staff and Project Management Oversight (PMO) Contractors (PMOCs). FTA maintains oversight for the grants that it awards, but assigns the grant administration and project management responsibility to the Project Sponsors. FTA assigns the responsibility for oversight of nearly all capital grants to the appropriate FTA Regional Office.

Dedicated use of the ***Guidelines*** should continue to contribute to effective project management on the part of the Project Sponsor, and effective oversight and guidance by FTA and the PMO contractor. Each project phase should: (1) start with inputs or a baseline, (2) have a process that refines the project definition and generates outputs that, (3) become the inputs or baseline for the subsequent phase.

By defining the requirements for each project phase along with sound approaches to their accomplishment, these ***Guidelines*** help the Project Sponsor to define requirements, allocate resources, perform project activities, manage project capital assets, monitor progress, and make adjustments, as required, to obtain the proper information and assure that timely decisions are made utilizing risk-informed and performance-based project management. Adherence to the ***Guidelines*** should minimize scope changes, schedule slippages, cost overruns, and quality problems, and contribute to fully meeting all of the performance objectives of the transit capital project.

Transit Asset Management

The Moving Ahead for Progress in the 21st Century (MAP-21) Act established a State of Good Repair (SGR) grant program under which the Project Sponsor must set targets for the condition of project capital assets – including equipment, rolling stock, infrastructure, and facilities. The Project Sponsor then reports on the condition of its system, any change in condition since the last report, and progress towards meeting its targets.

A national Transit Asset Management (TAM) system serves as a resource to the Project Sponsor for developing and reporting on its project TAM Plan. The TAM plan should include, at a minimum, capital asset inventories, condition assessments, and investment prioritization.

Participation in Project Planning and Design

Project Sponsor participants in the FTA Transit Construction Program Workshops have been of equal opinion that there is a need for transit operations and construction staff to be involved in planning and design of New Starts as well as modernization and/or expansion of transit systems. This coordination is essential to ensure that plans are feasible from transit operations, project construction, and revenue service start-up standpoints. Involvement by the local community also is essential at every stage of project development.

Because a sound management and control plan should be implemented early in the life of a project, the ***Guidelines*** encompass the planning phase, in addition to the design and construction phases, where the greatest level of effort is expended.

For completeness, the operational or revenue service phase is also presented to encourage a comprehensive life cycle management approach. This approach systematically assesses the relationship between the constructed transit capital project and operational realities to determine future system needs, both modernization and expansion.

The ***Guidelines*** address the full range of issues and present management principles applicable to all FTA-funded capital projects. These include projects that could encompass a variety of modes (e.g., rail, bus, other fixed guideway); improvement types (e.g., equipment, facility); system evolutions (e.g., newly developed, expanded, modernized); and Project Sponsor capacities, capabilities, and maturities (e.g., newly constituted or established with experienced staff). The ***Guidelines*** document is complemented by the FTA's *Construction Project Management Handbook*, designed for agencies executing a significant project for the first time with little or no internal capital projects staff.

1.2 Reasons for the Guidelines Update

This ***Guidelines*** update seeks to incorporate the requirements of Public Law 112-141, Moving Ahead for Progress in the 21st Century (MAP-21). It incorporates changes in regulations and policies, particularly in renewed emphasis on streamlining project development and implementation process cost containment through continuous risk identification, assessment and mitigation practices, and the experience gained over the intervening period from a variety of sources, including the following:

- Transit Construction Workshop recommendations
- Other FTA and industry-sponsored research, guidance, and best practices
- The results of wider use of non-traditional project delivery and development approaches
- Updates of the:
  - Grant Management Requirements
  - Full-Funding Grant Agreements Guidance
  - Program Guidance for Metropolitan Planning and State Planning and Research Program Grants

  - Elderly Individuals and Individuals with Disabilities Program Guidance and Application Instructions
  - Capital Investment Program Guidance and Application Instructions
  - Safety Management Systems and Processes
  - Buy America Regulations

- Applicable research and training initiatives of FTA, including National Transit Institute (NTI) courses on Management of Transit Construction Projects and Design/Build Project Development
- FTA publication of Circular 5800.1, providing a complete picture of requisite safety and security policies and guidelines to reflect the increasing attention devoted to the topic of Safety and Security Management Guidance for Major Capital Projects
- Additional experience with Financing Techniques for Public Transit
- Updated guidance for Land Acquisition and Relocation Assistance for Transit Projects, including railroad ROW acquisition
- FTA real estate acquisition matters
- Other new FTA regulations, circulars, rules, and guidelines related to topics addressed in the ***Guidelines***
- Transit and other industry approaches to contemporary project and construction management topics from such sources as the Project Management Institute, American Society of Civil Engineers (ASCE), American Public Transportation Association (APTA), and the Design-Build Institute of America (DBIA), to name a few

The update process also provided an opportunity to review the structure and format of the ***Guidelines*** to improve its effectiveness. The following section summarizes these changes.

1.3 Format and Content Summary

From a thorough review of the previous ***Guidelines***, and suggestions made by some of the FTA's Project Management Oversight Contractors working daily in the arena of transit capital projects implementation, an outline was developed that includes the following changes to date:

- Discussion has been further expanded on the Planning Phase in Chapter 2, the Transit Capital Project Development Process, to identify and reinforce the data and decision-making that is intrinsic to and should take place in that phase.
- Chapter 3, General Management Principles for Transit Capital Projects, identifies additional areas of importance and correlates them to the risk-informed, performance-based requirements for a robust project management framework.
- Three detailed, phase-oriented chapters follow: Managing the Project During the Design Phases (Chapter 4), Managing the Project During the Procurement and Construction phase (Chapter 5), and Managing the Project During the Testing and Start-Up Phase (Chapter 6). References to Preliminary Engineering and Final Design were deleted to comply with MAP-21 Act Project Development (PD) and Engineering phases. Discussion of the PD and Engineering phases has been expanded, with additional information on the system-wide project elements and

reinforcement of the transitional requirements between the phases being discussed within Chapter 2.
- Applicable provisions of FTA's Interim Policy Guidance of August 2015 are included.
- Sufficient level of engineering and design for each project phase is defined.
- Small Starts projects and other smaller projects not considered Major Capital Projects (MCPs) are treated, primarily in Chapters 2 and 3.
- Document references are incorporated, along with tips using text boxes and/or the pointer symbol as shown at right.

Looking for More Information?
*Throughout **Guidelines** chapters, the pointer symbol (☞) is a visual cue that the author has listed an additional source(s) of information.*

The remaining chapters of the ***Guidelines*** are summarized and presented as follows:

Chapter 2 – Transit Capital Development Process, addresses the primary categorization of projects and types of grants associated with each, with emphasis on FTA's funding process and grant requirements. Rail vehicle procurement is expanded upon in this chapter. For each development phase, the major work program elements that are vital to understanding the Basis for Design and that thereby influence effective project management are reviewed, noting significant milestones and decision points, with their interfaces highlighted. The primary elements and their foundation for sound transportation planning and project development phases are addressed, and include the following Phases:
- Project Development
    - Systems planning
    - Alternatives analysis
    - Engineering & design in support of the environmental review
    - Environmental review
- Engineering
- Construction and Equipment/Materials Procurement
- Testing and Start-Up
- Revenue Service

This chapter reinforces the role of the Project Sponsor as the responsible party for project management and describes the FTA requirements that the Project Sponsor needs to recognize and put into practice for effective project stewardship and management. The FTA requirements that apply during the project development phase and prior to an FTA capital grant funding commitment are designed to provide assurances that issues of project scope, cost estimation, environmental impacts, implementation process, schedule, and local funding commitments have been thoroughly addressed and resolved. These requirements aim to create a realistic project Basis for Design that the Project Sponsor may use to manage the project more successfully, should it advance to subsequent phases.

Incentives are another tool FTA uses to encourage effective Project Sponsor project management. For a Major Capital Project (MCP), the Full Funding Grant Agreement (FFGA) concept makes the Project Sponsor financially responsible for cost overruns and attaining the Revenue Service Date (RSD). In this manner of grant funding, Project Sponsors have the incentive to establish a realistic project baseline and to implement policies, practices, and procedures that are risk-informed, performance-based, means and methods of project control.

A Project Sponsor should apply the management principles and guidance embodied in this document to its unique project environment through the development of a Project Management Plan (PMP). Chapter 2 covers specific regulatory requirements for the PMP. A PMP, which is required by statute for MCPs, provides a functional, financial, and procedural route map for the Project Sponsor to effectively and efficiently manage on-time, within-budget, and at the highest quality and safety level in its unique project environment.

This Chapter includes definition of sufficient level of engineering for each phase of the project,

Chapter 3 – General Management Principles for Transit Capital Projects, outlines the general principles for managing the transit capital project development process throughout each of the phases of project implementation. In addition to the traditional project management requirements for managing scope, budget (including financing), schedule, and quality, effective project management requires the application of other management skills such as procurement management, continuous risk assessment and management, safety and security analyses and management, and internal and external communications management. Because transit capital projects are publicly funded and often have significant urban development impacts, these projects have many more legal and regulatory requirements than a privately developed project.

Chapter 3 groups the general principles for managing transit capital projects into the following functional categories:

- Project Sponsor and project organization
- Financial requirements/resources
- Scheduling
- Controlling the project
- Procurement, contracts, and related topics
- Quality assurance/quality control (QA/QC)
- Safety and security
- Communications – Internal and External

Chapter 3 purposely presents the project management principles in a general manner. The implementing agencies will have the responsibility to apply the general principles along with the specific guidance provided for the different project phases. FTA and its Project Management Oversight (PMO) and Financial Management Oversight (FMO) contractors monitor the project management process of Project Sponsors to assure compliance with FTA requirements and to assess the Project Sponsor's efforts to achieve management objectives (within budget, on schedule, safely, and highest quality products). Consequently, these ***Guidelines*** are intended to be firm in their definition of management principles and objectives, flexible in their application of standard and alternative approaches and techniques, and dynamic in their ability for FTA and Project Sponsors to consider new approaches and techniques in the future.

Chapter 4 – Managing the Project During the Engineering Design Phase, recommends specific management approaches for transit capital projects during design. The chapter expands upon topics with regard to procurement planning, contracting options, and National Environmental Policy Act (NEPA) compliance. Additional discussion provides the basis and application of design development and control requirements that best ensure control of project deliverables and a focus on "designing to budget" and maintaining the integrity of the project's Basis for Design.

Chapter 5 – Managing the Project During the Procurement and Construction Phases, recommends specific management approaches for transit capital projects during the Construction and Equipment/Materials Procurement Phase. A key ingredient this chapter highlights is for the continuance of risk-informed and performance-based project management and maintaining the integrity of the Basis for Design, much as these objectives are emphasized during the Design Phase. For the Construction and Procurement Phase, however, the ***Guidelines*** emphasize the Project Sponsor care that must be exercised to ensure delivery of the project elements in conformance with contract plans and specifications to achieve the project goals.

Chapter 6 – **Managing the Project During the Testing and Start-Up Phases**, recommends specific management approaches for transit capital projects during the Testing and Start-Up Phase. This phase is the period in which rigorous component inspection and testing is done, preceding integrated project testing and certifications that the system is safe and revenue service for the general public may begin.

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Appendices to enhance the effectiveness of the ***Guidelines*** include:

- Index of selected key words and phrases
- References that correspond to the [Ref.__] notations in the text
- Topical discussion papers, checklists and other guidance to aid in project management

CHAPTER 2 – TRANSIT CAPITAL PROJECT DEVELOPMENT PROCESS

2.1 Overview

It takes a lengthy and rigorous process to plan, design, program, and implement a transit capital project, particularly a major transit capital project. This process includes the following activities:

- Analysis of the existing transportation system in order to determine the need for improvements
- Evaluation of alternatives in terms of design and operational criteria, costs, benefits, and impacts, and the preparation of the necessary environmental documents to ensure compliance with the National Environmental Policy Act (NEPA)
- Financial planning to identify costs, funding requirements (initial capital funding and cash flow, and ongoing operational expenses) and sources (non-Federal and Federal)
- Reaching agreements with third parties and regulatory agencies
- Determining the optimal project delivery approach
- Preliminary hazard analysis (PHA) and a threat and vulnerability analysis (TVA) to develop design criteria that assure that safety and security are built into the project prior to the Engineering Phase and construction, so that costs and community issues do not escalate during later phases of the project
- Safety and Security Management including safety and security certification of the project
- Design necessary to achieve the desired performance in concert with all project design criteria and environmental and financial constraints
- Acquisition of the required ROW
- Construction of the improvement in accordance with the contract documents, plans and specifications
- Testing and start-up to assure that the system is safe and secure and meets operational requirements
- Continual monitoring during operations to assess system performance and identify requirements for additional improvements, such as modernization or expansion

The time frame and specific requirements to implement transit capital projects vary greatly depending on the type of improvement being considered. With regard to financing, for example, most projects will involve capital programming and competition for a limited amount of public funds. FTA capital assistance generally requires a continuous, comprehensive, and cooperative Metropolitan Planning Process (see the booklet entitled The Transportation Planning Process: Key Issues [Ref. 2-1] published by the FTA and FHWA). In the case of New Starts (NS) fixed guideway projects, the FTA requires a very rigorous project justification process subsequent to such a project being selected for advancement by the local government(s) beyond the long-range planning stage.

The degree of environmental impact also affects the implementation process. An NS project, for instance, has numerous positive and negative impacts related to route alignment, station locations, real estate acquisition and related relocations, land use implications, construction, and traffic generation. Effectively mitigating the adverse potential impacts of a project requires a process of public involvement to gather input and achieve support, especially to create stable sources of local funding.

A set of typical definitions, requirements, inputs, outputs, major milestones, and decision points associated with each of the transit capital project development phases is presented in the following sections. While these parameters may vary depending on the nature of the project, it is important for a Project Sponsor to determine the specific requirements associated with each project as a means of establishing a basis for effective project management. As the phases of project development are interrelated, proper attention to the management principles and external requirements at the earliest stage can eliminate potential problems that could result in schedule slippage and cost overruns in subsequent phases. FTA, under Congressional direction as a major funding source for public transportation, is committed to ensuring that a Project Sponsor has a process of project management that results in successful implementation of the desired project at the lowest cost. This requires a management process that is risk-informed and performance-based to control scope, quality, cost, schedule, safety and security, and project risk.

The following sections describe the FTA designation of MCPs that require special project management attention, and other projects that Project Sponsors develop with less direct Federal oversight.

2.1.1 Major Capital Projects

These definitions are essential to understanding the FTA capital project management requirements and the role of PMOCs resulting from the passage of MAP-21 Public Law 112-141) and the associated FTA statute, 49 U.S.C. Chapter 53 (as amended October 1, 2012). [Ref. 2-2]:

- **New Starts Project:** A new fixed guideway system or an extension to an existing fixed guideway system. FTA New Starts funding is provided through the Section 5309 grant program.
    - **Small Starts Project:** A Section 5309 capital investment program that contains less than $100 million of Capital Investment Grant (CIG) funding with a total project cost of less than $300 million. Guidance for New Starts, Small Starts, and Core Capacity Programs is contained in FTA's August 2015 Final Interim Policy Guidance for the Capital Investment Grant Program [Ref. 2-3].
- **Core Capacity Improvement Program:** A Core Capacity project involves substantial corridor-based investment in an existing fixed guideway system where the proposed project corridor:
    - Is located in a corridor that is at or over capacity or will be in five years.
    - Will increase capacity by 10 percent.
    - Does not include project elements designed to maintain a state of good repair.

- **Full Funding Grant Agreement (FFGA):** A means for providing Section 5309 funds to projects with a Federal share of $25 million or more. FFGAs establish terms and conditions for the Federal financial participation in an NS project.

- **Project Construction Grant Agreement (PCGA):** A means for providing Section 5309 funds to Small Starts projects with a Federal share of less than $75 million. PCGAs establish terms and conditions for the Federal financial participation for Small Starts projects [Ref. 2-4].

- **Fixed Guideway:** Any public transportation facility that utilizes and occupies a separate ROW or rails. This includes, but is not limited to, heavy rail, light rail, commuter rail, automated guideway transit (AGT), people movers, and exclusive facilities for buses, e.g., bus rapid transit (BRT).

- **Project Management Oversight (PMO) Program:** A Congressionally mandated continuous (or sometimes periodic) review and evaluation of various processes to ensure each project is in compliance with statutory, administrative, and regulatory requirements; that FTA national and Project Sponsor goals are reached; and to improve FTA and the Project Sponsors' project management processes and components. Oversight should be viewed as an increased emphasis on monitoring the adequacy of Project Sponsor management capability/capacity and management systems to ensure proper planning, technical, financial, and administrative control, which will result in improved Project Sponsor compliance with statutory and administrative requirements. PMO includes review of the PMP, project estimates, and schedules; and facilitating risk assessment and/or mitigation to assure that a project is within prescribed scope, schedule, and budget. PMO can be undertaken with FTA and/or contractor staff. The FTA Administrator may assign Project Management Oversight Contractor (PMOC) services when one or more of the following conditions apply:
  - The Project Sponsor is using FTA capital funds.
  - The project is an MCP (see MCP definition below).
  - The FTA administrator determines that it is in the best interest of the government.

- **Major Capital Project (MCP):** This is defined as a project that:
  - Involves the construction of a new fixed guideway or an extension to an existing fixed guideway.
  - Involves the rehabilitation of an existing fixed guideway with a total project cost in excess of $100 million, or
  - The FTA Administrator determines it to be an MCP because the PMO program may benefit the Project Sponsor. Typically, this means a project that involved all of the following:
    - Generally is expected to have a total project cost of $100 million or more for construction.

- Is not exclusively for the routine acquisition, maintenance, or rehabilitation of vehicles or other rolling stock.
- Involves new technology.
- Is of a unique nature for the Project Sponsor, and/or involves a Project Sponsor whose experience indicates that the implementing agency may benefit from the oversight or technical assistance available through the PMO Program.

- **Project Management Plan (PMP):** An overarching document that demonstrates a Project Sponsor's authority and its management capacity and capability to implement and maintain a new transit capital project together with any existing public transit system elements. PMPs and sub-plans are required to be submitted initially prior to Project Development (PD) and updated through subsequent project phases. PMPs are required for all MCPs.

Figure 2-1 depicts the NS project planning and PD process under MAP-21 [Ref. 2-5], which includes key Project Sponsor activities, and FTA actions and decision points. PMOCs are normally assigned to NS projects within six months prior to the completion of NEPA compliance. This figure depicts the process typical for the Design/Bid/Build (D/B/B) contract delivery method, and may also be appropriate for Design/Build (D/B) contracting wherein a partial notice to proceed (NTP) could be used to initiate the Engineering Phase, with full construction at a later NTP. Planning and project development for NS and Core Capacity projects is a continuum of analytical activities carried out as part of the metropolitan planning and NEPA review processes. Systems planning results in the identification and prioritization of transportation corridors in greatest need of more detailed planning and analysis. Alternatives analysis (AA) focuses on a specific transportation corridor need (or set of needs), identifies alternative actions to address these needs, and generates information needed to select an option for further engineering and implementation. AA typically results in the selection of a locally preferred alternative (LPA) and initiation of the environmental review process under NEPA. Once an LPA is selected and adopted in the region's long-range plan and the NEPA process initiated, the Project Sponsor may request FTA entrance into the PD Phase.

PD includes additional engineering analysis and results in the completion of all environmental requirements, with the preparation of a final Environmental Impact Statement (FEIS), environmental assessment (EA) or Categorical Exclusion (CE). The environmental process is completed when FTA issues the Record of Decision (ROD), Finding of No Significant Impact (FONSI) or confirms the CE. The PD Phase must be completed within two years, and FTA has expressed its intent to issue few extensions to the two-year time frame. The next stage of development for NS and Core Capacity projects is Engineering. Entry into the Engineering Phase is the first opportunity for FTA to evaluate and rate a project, prior to giving its approval. The FTA sets the maximum amount of Federal funding for the project when it approves the project's entry into Engineering. It is during the Engineering phase that candidate projects are considered by FTA for an FFGA. In the case of Small Starts projects, the project moves from PD Phase to the award of a Small Starts Grants Agreement (SSGA).

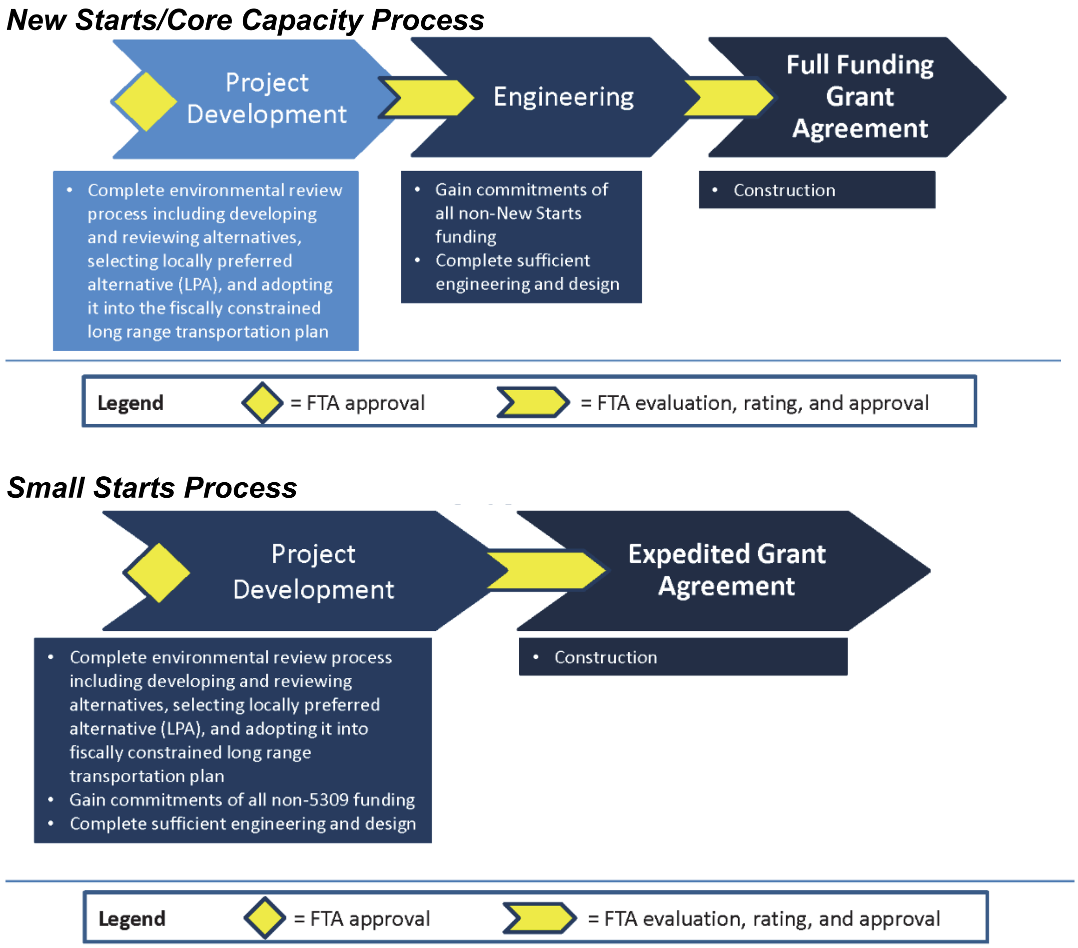


Figure 2-1. MAP-21 New Starts/Core Capacity and Small Starts Planning and Project Development Process

2.1.1.1 *Automatic Pre-Award Authority and Letters of No Prejudice*

Although an FFGA is important to MCPs, FTA has established automatic pre-award authority that enables a Project Sponsor to proceed with aspects of the capital project prior to FTA making a capital grant and/or an FFGA. These pre-award authorities, the Letter of No Prejudice, and Early Systems Work Agreements are discussed below.

Under existing practice, FTA extends automatic pre-award authority for the acquisition of real property and real property rights and associated relocations for a New Start, Core Capacity, or Small Starts project upon completion of the NEPA process for that project. The NEPA process is complete when FTA signs an environmental ROD or FONSI or makes a CE determination.

FTA also grants pre-award authority for utility relocation upon completion of the NEPA process for New Start, Core Capacity, and Small Starts projects.

FTA extends pre-award authority for non-construction activities upon entry into Engineering for NS and Core Capacity projects. The intent of this authority is to facilitate procurement of long-lead time items or items for which market conditions play a significant role in the acquisition price. The following list of non-construction activities is illustrative rather than exhaustive:

- Procurement of rails, ties, and other specialized equipment
- The procurement of commodities
- Demolition

FTA does not extend additional pre-award authority for Small Starts in the PD Phase. FTA reminds Project Sponsors that the procurement of vehicles must comply with all Federal requirements including, but not limited to, competitive procurement practices, the Americans with Disabilities Act (ADA), and the Buy America Act. Project Sponsors should discuss the procurement of vehicles with FTA in regards to Federal requirements prior to exercising pre-award authority.

Because Small Starts projects are not subject to approval into Engineering, they must complete the NEPA requirements and obtain a Letter of No Prejudice (LONP) for the following activities to remain eligible for reimbursement or as credit toward local match:

- Procurement of vehicles, rails, ties, and other specialized equipment
- The procurement of commodities
- Demolition

Project Sponsors should contact their FTA Regional Office for a determination of pre-award authority for activities that are not listed here but meet the intent described above.

FTA reminds Project Sponsors and the public that local funds expended by the Project Sponsor pursuant to and after the date of the pre-award authority are eligible for reimbursement or as credit toward local match only if FTA later makes a grant or grant amendment for the project. Local funds expended by the Project Sponsor prior to the date of the pre-award authority are not eligible for credit toward local match or reimbursement.

The aforementioned automatic pre-award authority provisions reduce the need for LONPs. FTA will still consider LONPs for activities not covered by automatic pre-award authority. FTA will, following the completion of the requirements under NEPA, expedite the issuance of LONPs, when appropriate, by no longer performing a detailed review of the cost and scope of the request in every instance. Rather, a limited review will be performed in those cases that are of a more routine nature, especially those involving an experienced sponsor.

Before incurring costs for a project element not covered by automatic pre-award authority, the Project Sponsor must first submit a written request for an LONP, accompanied by adequate information and justification, to the appropriate regional office and obtain written approval from FTA.

FTA typically updates its guidance on pre-award authority, LONPs, and other program information annually by notices published in the Federal Register. The most recent update as of November 2015 was FTA Fiscal Year (FY) 2015 Apportionments, Allocations, and Program Information, 80 CFR 26, February 9, 2015.

FTA approval of an LONP for an NS or Small Starts project is determined on a case-by-case basis. Federal funding for a New or Small Starts project is not implied or guaranteed by an LONP.

Specifically, when requesting an LONP, the applicant shall provide sufficient information to allow FTA to consider the following items:

a. Description of the activities to be covered by the LONP.
b. Justification for advancing the identified activities. The justification should include an accurate assessment of the consequences to the project scope, schedule, and budget should the LONP not be approved.
c. Allocated level of risk and contingency for the activity requested.
d. Status of procurement progress, including, if appropriate, submittal of bids for the activities covered by the LONP.
e. Strength of the capital and operating financial plan for the NS project and the future transit system.
f. Adequacy of the Project Management Plan.
g. Resolution of any readiness issues that would affect the project, such as land acquisition and technical capacity to carry out the project.

These policy and procedural matters have ramifications. First, an LONP is not an indication by FTA that the project is a promising candidate for either an FFGA or SSGA. Second, the Project Sponsor assumes virtually all risks. LONPs allow a Project Sponsor to incur costs using non-federal resources, with the understanding that the costs incurred subsequent to the issuance of the LONP may be reimbursable as eligible expenses or eligible as credit toward the local match only if FTA approves the project for funding at a later date. Federal funding is not implied or guaranteed by an LONP. This level of FTA oversight has expedited the delivery of NS and Small Starts projects, but also requires diligence on the part of Project Sponsors to ensure that public funds are expended wisely.

In addition to the above processes, the potential Project Sponsor should be aware that the FTA will conduct its own assessment of the financial capacity of grant applicants through Financial Management Oversight. [Ref. 2-6].

2.1.2 Capital Projects Not Classified as Major Capital Projects

The following subsections describe types of transit capital projects that are not considered MCPs and, therefore, not automatically subject to continuous FTA oversight and PMO involvement. Despite the absence of PMO for these projects, Project Sponsors should consider the unique project requirements and must design an appropriate project management process using the principles described in the ***Guidelines***. Many of these projects will involve modifications to an existing transit system, the continuing operation of which must be carefully considered during planning, design, construction, and start-up. Such projects must also be included in the Regional Transportation Plan (RTP), the Transportation Improvement Program (TIP), and the Statewide Transportation Improvement Program (STIP). MAP-21 requires the Project Sponsor to use the Transit Award Management System (TrAMS) for the management of grants [2-7].

FTA capital funding provided for fixed guideway modernization, bus, and bus-related projects is detailed in 49 U.S.C. § 5307, 5336, and 5340/MAP-21 Sections 20007 and 20026.

2.1.2.1 *Transit Asset Management Practices*

Transit asset management (TAM) [Ref. 2-8] is the process of implementing capital improvements to maintain existing fixed guideway systems in a “state of good repair” (or SGR) [Ref. 2-9] to provide efficient and effective service. Projects can involve a variety of elements related to track, structures, stations, traction power substations and distribution, signals, communications, yards, and shops. Except in situations where the modernization is minor, all changes in facilities’ design or location should include a PHA and TVA prior to Engineering and the development of construction bid requirements. The safety and security certification process should also be described and necessary plans included in contract documents.

The asset management process is vital to effective maintenance of a fixed guideway system. More information on this transit asset management topic are reflected in DOT/FTA TAM practices as prescribed by MAP-21 [Ref. 2-10, 2-11].

2.1.2.2 *Bus Maintenance Facilities*

Construction of a completely new bus maintenance facility, or major modernization of an existing facility can be a complex undertaking due to the desire to organize and optimize the bus operating and maintenance (O&M) processes to produce maximum efficiency. For new facilities, the site acquisition and development process can be difficult because of the perceived negative impacts of such a facility. The FTA *Construction Project Management Handbook* was developed and updated to assist in guiding Project Sponsors in the development and construction of such facilities. The transit asset management process (as discussed above) is applicable to all bus facilities, inclusive of fixed transit stops, transfer facilities, etc.

2.1.2.3 *Vehicle Procurements*

Rail system vehicle procurements are most often accomplished in conjunction with a new start or a major extension; the exception is for the replacement of aging railcars or overhauling them to extend their useful life. For larger fixed guideway systems, replacement can be a significant undertaking costing hundreds of millions of dollars and, at the discretion of the Administrator, warranting FTA oversight. Bus system vehicle replacements are a more routine process due to the much shorter life expectancy of the vehicles, resulting in more frequent procurement and less likely FTA oversight.

FTA requires that a Fleet Management Plan (FMP) be prepared (New Starts) or updated for existing transit agencies for all bus and rail systems in support of NS projects. The FMP is intended to ensure that Project Sponsor has presented a sound basis and an accurate estimation of Peak Vehicle Requirements (PVR) and Operating Spares Ratio (OSR) for the fleet. While specifics of development of PVR and OSR for bus fleets are less formal, for rail fleets FTA Circular 9030 states:

> *An operator of a rail system must have in its file available upon request by FTA a fleet management plan that addresses operating policies (level of service requirements, train failure definitions and actions); peak vehicle requirements (service period and make-up, e.g., standby trains); maintenance and overhaul program (scheduled, unscheduled, and overhaul); system and service expansions; rail car procurements and related schedules; and spare ratio justifications.* [Ref. 2-12]

Each plan should consider a minimum time frame of ten years from the date of the initial analysis. Plans should include:

- An Introduction
- A Definition of Terms
- A Description of the Existing System
- Any Future Expansion Plans
- Demand Forecasting for Revenue Vehicles
    - Determine peak passenger demand.
    - Define and adopt passenger load standards and calculate load factors.
    - Determine vehicle run times.
    - Calculate the number of cars required during peak periods.
    - Establish PVR.
    - Determine use of any gap or ready reserve trains.
    - Calculate number of spare rail cars required.
    - Determine total fleet demand and spare ratio.
- Plans, inclusive of strategic, administrative and technical means and methods for reducing operating costs and increasing vehicles service reliability
- The Project Sponsor's reliability program, past performance and plans to improve vehicles reliability and operations efficiencies
- Section on plans for improvements in the utilization of assets
- Report on vehicles reliability such as Mean Distance Between Failures (MDBF), with references to the performance of various vehicles in the fleet reported in the FMP
- Introduction of the concept of "design for maintenance," e.g., requiring the car builder to design quick-disconnects to drop a truck of a railcar in two hours or replace an air-conditioning unit in an hour

Updates should be performed upon any major changes to the fleet operation. As Project Sponsors progress through phases from PD to design and implementation, additional substantive detail should be included in the FMP as appropriate.

2.1.2.3.1 Transit Vehicles Procurement:

All agency vehicle procurements are to be performed in conformance with applicable regulations and guidance, and must ensure compliance with vehicle specifications, system design criteria, industry “best practices” and manufacturing approaches, etc., to meet vehicle program requirements.

FTA encourages Project Sponsors to procure vehicles of existing “proven” designs and/or combine their vehicle procurements with other agencies for economies of scale in sharing the upfront design and development costs.

Project Sponsor’s procurements of road and rail vehicles should ensure that the vehicles being procured:

- Meet the agency’s intended use and satisfy the transit system ridership projections and objectives
- Represent sustained performance and “life cycle cost” for the product to be selected
- Meet the regulatory, mandated requirements; including ADA, FMVSS, etc.
- Include the “best value” while incorporating appropriate technologies to provide for:
  - Safety and security
  - Emergency evacuation, tools and First Aid kits that could include heart defibrillators
  - Vehicle car body material preferences (stainless or carbon steels, aluminum, or composites)
  - Traction power, hybrids, propulsion and automatic controls
  - Quality standards and controls
  - Passenger comforts and amenities
  - Workmanship
  - Economy of operation
  - Design for vehicle minimum life expectancy (25 years for rail vehicles, 5 to 12 years for buses, depending on their size and design, and appropriate vehicle life for ferries and other vehicles not specifically identified by FTA)
    - Weight control and balance
    - Reliability
    - Maintainability including targets to perform selected maintenance tasks in specified time
    - Interchangeability
    - Suitability for the purpose intended

2.1.2.3.2 Regulatory References

Vehicle Specifications should provide the clear understanding of the agency’s intent dependent upon the procurement methodology chosen. The Vehicles should be designed and built to comply with all applicable laws, regulations, standards, and recommended practices of the following agencies and organizations:

- DOT
- Federal Railroad Administration (FRA)
- FTA
- Department of Homeland Security (DHS)/Transportation Security Administration (TSA)
- EPA
- Food and Drug Administration (FDA)
- APTA
- State and other local jurisdictions, including the State Safety Oversight (SSO) program standard
- Association of American Railroads (AAR)
- Applicable FAR regulations
- Applicable Code of Federal Regulations (CFR), including but not limited to Buy America requirements and audits, defined in 49 CFR Parts 661 and 663 [Ref. 2-13, 2-14, 2-15]

The following are the principal, but by no means the only, references to Federal legislation, regulation, and guidance by which the Project Sponsor's procurement is governed:

- CFR, especially 49 CFR Parts 661 and 663 governing Buy America requirements and audits
- 49 CFR Parts 27, 37 and 38 regulations implementing the transportation provisions of the ADA [Ref. 2-16, 2-17, 2-18, 2-19]
- FTA Circular 4710.1 providing guidance pertaining to ADA [Ref 2-20]
- FTA Circular 4220-1F, which provides guidance for Project Sponsors on third-party contracting practices allowable under Federal regulations [Ref. 2-21]
- Other Federal regulations (such as regulations governing interstate commerce) and state regulations.
- FTA's Best Practices Procurement Manual (BPPM), a comprehensive guide regarding oversight of transit procurements [Ref. 2-22]

2.1.2.3.3 Vehicle Procurement Deliverables

Through the vehicle procurement contract, the Project Sponsor must obtain and provide supporting information to demonstrate through analysis and testing, including proof of design, maintainability, safety, security, serviceability, reliability, and configuration control and management.

Dependent upon the type of vehicles being procured, typical processes include needs analysis, industry surveys, cost estimates, schedule preparation, performance and design criteria, specification preparation, solicitation, contract award and management, conceptual design, preliminary design, engineering, first article inspection, manufacture, testing, delivery and commissioning, etc.

Project Sponsor deliverables for FTA review under 49 U.S.C. § 5325, 18 CFR 18.36(i) and 49 CFR 633.17 include:

- Environmental documents, including EPA exhaust emission and smoke and fire requirements
- Project description – grant application
- Project specifications
- List of drawings and supporting information on analysis and testing, including proof of design, maintainability, safety, serviceability, reliability, configuration control, and management
- Quality Assurance and Quality Control Plan for Vehicles
- Schedule, issues potentially impacting schedule, and issues actually impacting schedule
- Vehicle safety issues including:
  - Applicable structural strength and energy absorption for ends, sides and rollover resistance
  - Avoiding single point failures of safety critical components of the vehicle
- Vehicle reliability, availability, and maintainability, including the frequency of failure, expressed as failures per hour or failures per mile
- Issues impacting vehicle operability, including faulty or unreliable vehicle designs or systems
- Known component or material deficiencies and availability of replacement parts
- Testing Program Plan, including test procedure lists for components, systems, vehicles and trains:
  - Weld and assembly testing
  - Car body structural testing
  - Truck structural dynamic fatigue testing
  - Water tightness testing
  - Systems and components factory testing
  - Heating, ventilation, and air conditioning (HVAC) climate room testing
  - Floor fire resistance and material and components heat release rates
  - Vehicle functional testing
  - Performance test on track

Typical contractual requirements from the vehicle designer include, but are not limited to, the following:

- Evaluation of ADA compliance issues
- Evaluation of accessibility and maintainability of components and assemblies
- Review of issues involving human factors/ergonomics and safety/emergency concerns, and Preparation of an Ergonomic Analysis and Report for seating and interior arrangement
- Integration of materials, finishes, colors, and arrangements
- Preparation of exterior markings and signage
- Preparation of interior markings and signage

- Selection and presentation of interior materials, lighting, finishes, furnishings, and colors
- Construction of mock-ups required to resolve packaging, spaces, human factor/ergonomics, and ADA issues
- Fire Safety Analysis
- Development of test procedures and conducting tests

Typical design package shall include, as applicable, the following information:

- System design implementation:
    - System functional description (system, vehicle and train levels)
    - Block diagrams (system, vehicle and train levels)
    - System schematics (interconnection diagram)
    - System assembly drawings
    - Component and material data sheets
    - Definition and list of characteristics for system, vehicle and train interfaces
    - System installation, maintenance access and special tool drawings
    - Manufacturing scheme (who, what, where, when, and how)
- Weight schedule and balance requirements:
    - Calculated/actual weights broken down to system component level
- Software Documentation:
    - Software requirements specification
    - Software requirements traceability matrix
    - Software design description
    - Software verification and validation report
- Reliability, Accessibility, Maintainability and System Safety:
    - Reliability prediction analysis with support information
    - Maintainability analysis (preventative and corrective)
    - Reliability summary
    - Safety analysis and traceability matrix
    - Emergency evacuations, provisions and tools
    - Lowest removal unit list
    - Electro-Magnetic Interference (EMI) control plan and shielding of electronic components
    - Fire safety analysis and test plan

Project Sponsors are required to follow FTA rules for such items as Buy America requirements and capital leasing, as well as meet other vehicle procurement guidelines.

2.1.2.3.4 Buy America Requirements for Revenue Service Vehicles

A Project Sponsor purchasing vehicles to carry passengers in revenue service must ensure that a pre-award audit as described in 49 CFR 663.21 is complete before the entering into a formal contract for the purchase of the vehicles. Similarly, a Project Sponsor purchasing revenue service vehicles must also ensure that a post-delivery audit as prescribed in 49 CFR 663.31 is complete before the title to the rolling stock is transferred to the Project Sponsor.

The minimum requirements for final assembly differ between bus and rail vehicles. 49 CFR 661.11(r) defines "final assembly" as "the creation of the end product from different elements brought together for that purpose through the application of manufacturing processes." The following paragraphs delineate the final assembly differences for bus and rail vehicles:

(1) Bus: Most heavy-duty transit bus manufacturers use a two-stage manufacturing process in which buses are partially built abroad and then assembled in the U.S. FTA no longer requires that bus manufacturers install certain components and subcomponents in the U.S. FTA allows installations abroad which have been shown to be helpful in maintaining the structural integrity of bus frames shipped to the U.S. FTA recognizes foreign assembly of doors, windows, axles and/or wheels, brakes and brake subcomponents may occur prior to shipment to the U.S. for final assembly.

(2) Rail: For rail vehicles, the domestic final assembly operations, at a minimum, must include the installation and interconnection of propulsion control and cooling equipment, brake equipment, power sources for auxiliaries and controls, HVAC, communications equipment, bogie/truck assemblies (including frames, suspension, wheels and axles, and motors), inspection of all installation and interconnection work, and factory functional tests on the vehicles in order to comply with Buy America.

The following are the principal, but by no means the only, references to Federal legislation, regulation, and guidance:

- United States Code
  - 49 U.S.C. Chapter 53, specifically § 5323(j)
- Regulations
  - Buy America Requirements, 49 CFR Part 661
  - Pre-Award and Post-Delivery Audits, 49 CFR Part 663
- Guidance
  - FTA "Dear Colleague" letter on Buy America Pre-Award and Post-Delivery Audits/Reviews [Ref. 2-23]

2.1.2.3.5 Pre-Award Audit Requirements

The Project Sponsor must certify through pre-award audits that the procurement of new revenue service buses, rail vehicles, and vans, using FTA-appropriated funds, is Buy America compliant. Failure to comply with Buy America requirements can put the Project Sponsor's FTA grant in jeopardy.

Pre-award audits are required before a Project Sponsor can enter into a formal contract for the purchase of such rolling stock with a manufacturer. The Pre-Award review period begins when the Project Sponsor issues the solicitation and ends when the Project Sponsor signs a formal contract with the selected manufacturer.

The following certifications are required for each Pre-Award audit:

- Pre-Award Buy America certification, verifying 60 percent domestic component value for each vehicle type
- Confirmation that final assembly of the vehicles will take place in the United States
- Pre-Award Purchaser’s Requirements certification
- Pre-Award Federal Motor Vehicle Safety Standards (FMVSS) certification (for buses and highway vehicles only)

In addition, compliance is required with requirements stipulated on the FTA Buy America website. The Project Sponsor should make certain that its Buy America team has exercised due diligence and “drilled down” to the lowest level required, in order to demonstrate that the “60 percent rule” has been satisfied and the content claimed is valid. For example, the following certifications and supporting documents may be subject to FTA review:

- Pre-Award Buy America Certification Requirement – The Project Sponsor must verify that final assembly of the vehicles takes place in the United States and that greater than 60 percent of the cost of all components is from components that are manufactured in the United States.
- The Project Sponsor must ensure that component manufacturing requirements are met, and identify instances where there may be doubt regarding a vehicle’s Buy America compliance – e.g., where major sub-assemblies of a component are made out of country but incorporated during final assembly of the vehicle in the United States.
- Pre-Award Purchaser’s Requirements – The grantee must verify that the manufacturer’s bid specifications are in compliance with the grantee’s solicitation specifications, and ensure that the manufacturer has adequate capacity and capability to execute the contract in fulfillment of the contract requirements. Project Sponsors are advised to consult the FTA Buy America website for recent changes.
- Pre-Award Federal Motor Carrier Safety Standards (FMVSS) Requirements (for bus and van procurements) – The Project Sponsor must obtain a letter (self-certification) from the vehicle manufacturer stating the information that is required for the FMVSS vehicle plaque to be provided. Upon review of the acceptability of the manufacturer’s certification (or certification of FMVSS inapplicability), the grantee must complete a Pre-Award FMVSS Certification for the project.

Beyond the required pre-award and post-delivery audits, Project Sponsors are encouraged to evaluate their procurement projects for the need to include a requirement for intermediate Buy America review(s)/audit(s). The intermediate audit would provide early validation of the contractor’s compliance with Buy America requirements especially that the cost of domestic components is more than 60 percent of the cost of all components based on review of documentation of actual component costs. Intermediate audit should occur at the approximate midpoint of the production series.

2.1.2.3.6 Post Delivery Audit Requirements

The Project Sponsor must complete a Post-Delivery audit before a vehicle title is transferred from the manufacturer to the Project Sponsor. Certifications must be kept in the Project Sponsor's files for future FTA reviews.

The following certifications are required for each Post-Delivery audit:

- Post-Delivery Buy America certification, verifying 60 percent domestic component value for each vehicle type
- Post-Delivery Purchaser's Requirements certification
- Post-Delivery FMVSS certification (for buses and highway vehicles only)

In addition, the Project Sponsor's compliance is required with all requirements stipulated on the FTA Buy America website.

For the Post-Delivery Purchaser's certification, the Project Sponsor must certify that:

- A resident inspector (on behalf of the Project Sponsor) was on site in the manufacturing facility during the final assembly period for procurement of rail vehicles or more than ten buses, and has (a) monitored the final assembly process, (b) observed that the components assembled on each vehicle are of the same sources as used in the Buy America audits, and (c) completed a final report describing the construction activities and explaining how the construction and operation of the vehicles meet the contract specifications.
- The Project Sponsor (or entity on behalf of the Project Sponsor) performed visual inspections and performance tests to demonstrate that the vehicles meet the contract specifications.

2.1.2.4 *Multimodal Transfer Facilities*

Multimodal transfer facilities, after maintenance facilities and new vehicles, are among the most significant capital projects related to bus systems. They require project planning, environmental review, and project management to assure their effective implementation. All changes in facilities' design or location should include PHAs and TVAs prior to Engineering and the development of construction bid requirements. Additionally, all plans should be reviewed for conformance with principles of Crime Prevention Through Environmental Design (CPTED) and Situational Crime Prevention (SCP) as part of the planning and review process to minimize costs and community resistance to new or enlarged facilities.

2.1.2.5 *Bus Rapid Transit (BRT) Projects*

FTA is promoting the benefits of BRT. The scopes of BRT projects are generally under the threshold required for an SSGA. The scopes of some BRT projects exceed those of previous FTA bus fixed guideway initiatives related to busways and HOV lanes, and may be designated NS projects that would require an FFGA. It is also possible to advance BRT system elements as incremental improvements to bus routes. These could include projects to improve the exclusivity or priority of transit operations, techniques to reduce the stop dwell time, and other enhancements to improve the efficiency and productivity of the bus system. Principles of Crime Prevention Through Environmental Design (CPTED) and Situational Crime Prevention (SCP) should be considered in design and placement of stops, shelters, and equipment selected to monitor bus movements.

2.1.2.6 *New Technology Procurements*

While many procurements to apply new technology – including Intelligent Transportation Systems (ITS) – to existing transit systems may be relatively small compared to other capital projects, they are usually complex and require special planning and management attention to assure their effective implementation. These can include advanced signal, fleet management, communications, fare media, information processing, and security systems that enhance the performance and efficiency of public transit O&M functions.

2.2 Project Development Elements of Sound Transportation Planning

FTA provides planning funds for Metropolitan Planning Organizations (MPOs) and State Departments of Transportation for Metropolitan Planning required under Section 5303 and Statewide Planning required under Sections 5304 and 5305.

The earliest phase in project development is Planning, during which the project scope is initially defined. In this phase, a broad range of issues are considered, including service parameters, community needs, ROW requirements, environmental impacts and project delivery options. Further conceptual planning will occur during PD or in other long- or short-range studies that consider transit development. Following are descriptions of the various activities that define transit project concepts as early as the planning phase, even though they may be refined in subsequent phases.

2.2.1 Systems Planning

The codification of the laws authorizing the Federal Transit Program begins by expressing the Congressional finding that "It is in the national interest to encourage and promote the safe and efficient management, operation, and development of surface transportation systems that will serve the mobility needs of people and freight and foster economic growth and development within and between States and urbanized areas, while minimizing transportation-related fuel consumption and air pollution through metropolitan and statewide transportation planning processes” under 49 U.S.C. Chapter 53 § 5303. To implement this policy, each MPO, in cooperation with the state(s) and public transit operators within its jurisdiction, is required to develop transportation plans and programs for its urbanized area(s) within the state(s). Both the FTA and the Federal Highway Administration (FHWA) provide funds to states that are in turn provided to MPOs to carry out the transportation planning process. The FTA and FHWA, to achieve consistency in their planning requirements, have also issued joint regulations regarding transportation planning:

- Joint FHWA/FTA regulations, "Planning Assistance and Standards (23 CFR 450 and 49 CFR 613,specifically Subpart B, "Statewide Transportation Planning," and

Subpart C, "Metropolitan Transportation Planning and Programming") [Ref. 2-23 and 2-24]
- Joint FHWA/FTA regulations for Management and Monitoring Systems, 23 CFR 500 and 49 CFR 614 [Ref. 2-25 and 2-26].

FTA and FHWA have also established the “Transportation Planning Capacity Building” program to deliver products and services that provide information, training, and technical assistance to the transportation professionals responsible for planning for the capital, operating, and maintenance needs of our nation's surface transportation system. The TPCB website is a one-stop clearinghouse for state-of-the-practice transportation planning information and resources. On this website, you will find planning news and events, regulations, policies, training information, technical resources, and peer exchange reports [Ref. 2-27].

Each state and MPO is required to develop and periodically update a long-range transportation plan covering a forecast period of at least 20 years. The state plan must integrate each metropolitan long-range transportation plan into the larger, consistent plan and must also plan for areas not covered by MPOs in the state. These long-range transportation plans must address all NS and other major facilities projects, including those earmarked in Federal authorizing legislation.

This metropolitan transportation planning process should develop a regional, multi-modal transportation plan with a 20-year horizon. This plan, among other things, must:
- Identify the projected transportation demand in the area over the period covered by the plan.
- Identify adopted congestion management strategies, including high occupancy vehicle (HOV) treatments and Public Transportation Facilities and Equipment Management System (PTMS) improvements to preserve and make the most efficient use of the existing transportation system (including requirements for operational improvements, as well as operations, maintenance, modernization, and rehabilitation of existing and future transit facilities).
- Quantify the capital investment necessary to demonstrate a systematic approach in addressing current and future transportation demand and to relieve vehicular congestion and enhance the mobility of people and goods.
- Include design concept and scope descriptions of all existing and proposed transportation facilities in sufficient detail to permit determinations under the U.S. Environmental Protection Agency (EPA) Conformity Regulations for metropolitan areas which do not meet air quality standards (known as non-attainment areas or NAAs) or in areas which have recently attained such standards (known as maintenance areas). In all areas, all proposed improvements should be described in sufficient detail to develop cost estimates.
- Reflect consideration of the area's long-range land use plan, development objectives, and social and environmental goals.

In addition, 23 CFR 450.306 identified eight factors for planning processes to consider in identifying projects for inclusion in plans and programs:

- Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency
- Increase the safety of the transportation system for motorized and non-motorized users
- Increase the security of the transportation system for motorized and non-motorized users
- Increase accessibility and mobility of people and freight
- Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns
- Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight
- Promote efficient system management and operation
- Emphasize the preservation of the existing transportation system

The metropolitan transportation planning process defines future demand forecasts on the public transit system. This information is needed to determine performance and capacity requirements of the future transit system. For bus systems, future service requirements would be needed to determine numbers and types of vehicles that will need to be acquired as well as the number, size, and location of maintenance and storage facilities. For rail modernization, future demand forecasts are needed to analyze and size all of the subsystems, such as the system headway requirements used to design control and communications systems.

The need for new starts or other means to increase capacity can be determined once the metropolitan transportation planning process has identified transportation demand, congestion problems, land use and development plans, and social and environmental goals. Local officials can then select and rank competing corridors in order of priority for improvement or new development. An alternatives analysis (AA) can be conducted regarding each corridor among those most in need of improvement to first consider the transportation problems, alternative solutions, and likely costs and benefits of those alternatives, and then to identify a preferred solution.

In planning and programming public transit improvements, consideration must be given to the region's financial capacity to modernize, operate, and maintain its existing transit system. This consideration becomes significant in those regions that have inadequate levels of local financing for modernization of their existing transit infrastructure. Planning studies that address long-term modernization needs can lead to the establishment of enhanced local funding resources or recommendations to reduce the magnitude of the existing system.

An important output of the metropolitan transportation planning process is the Transportation Improvement Program (TIP). The TIPs for the various metropolitan areas throughout the state should then be incorporated into a Statewide Transportation Improvement Program (STIP). The TIP should include a list of all transportation projects proposed for funding over the next three years. As the TIP must be financially constrained by year, it represents a prioritized listing of the area's transportation investments.

Additional guidance regarding the relationship between Capital Program grants and the metropolitan and statewide planning process is provided in Appendix A of FTA Circular 9300.1B, Capital Investment Program Guidance and Application Instructions [Ref. 2-28].

2.2.2 Alternatives Analysis

When the metropolitan transportation planning process identifies the need for a major transportation investment, it may then undertake an AA. The AA process includes what was previously known as a Major Investment Study (MIS). At the discretion of local authorities, the AA may include the undertaking of a Draft EIS (DEIS) or Environmental Assessment (EA).

The AA evaluates an appropriate number of mode and alignment alternatives for addressing a transportation problem. When decision-makers at the state or local level wish to initiate an AA, the specific scope should be determined cooperatively by the MPO; the state DOT; public transit operators; environmental, resource, and permit agencies; local officials; and any other agencies that may be impacted by the proposed scope being developed. This cooperative process will determine the range of alternatives to be studied (including alternative modes, technologies, and generalized alignments), the non-capital or low capital-intensive options, and the policies and methods to be employed in the study.

The alternatives evaluated in the AA may include a No-Build alternative, a transportation system management (TSM) alternative, and an appropriate number of build alternatives. If the local sponsors agree it is appropriate, the No-Build alternative may also serve as the baseline alternative. The AA develops information on the benefits, costs, and impacts of these alternative strategies.

Factors that must be considered in the AA include mobility improvements, social, economic, and environmental effects, safety, security of the facilities and operating environment, operating efficiencies, land use, economic development, financing, and energy consumption. The AA process is concluded with the formal adoption of an LPA, discussed earlier in this chapter, which must be one of the alternatives analyzed in the AA process, and its inclusion in the MPO’s financially constrained long-range regional transportation plan.

Public review and participation is a vital part of an AA. The work conducted in an AA is performed locally by the transit operator, MPO, and agencies of municipal and state government working in collaboration to attain a consensus on an LPA. In addition, environmental agencies at all levels and local officials should be involved. A local lead Project Sponsor must be defined and the roles and responsibilities the Project Sponsor and the other agencies and consultants clearly established. Participating local and state agencies are responsible for ensuring that the study is conducted in a technically sound manner. FTA and FHWA are also participants in the process, along with other affected agencies such as U.S. Department of Housing and Urban Development (HUD) and other community development and housing agencies.

2.2.3 Project Management Plan (PMP)

The PMP is the overarching documentation of the project that essentially spans the project period commencing no later than the completion of the PD Phase and continuing through the closeout of the planned capital grant for the project, be that an FFGA grant or other grant made through the FTA capital grant programs. The PMP is an evolving document used by the Project Sponsor to establish and disseminate its policies and practices for governing all requisite project activities. It includes procedures for Project Sponsor management and staff (and all third parties as applicable to project need and/or implementation techniques) that best ensure that performance is (qualitatively and quantitatively) measurable through sound design, engineering, and comparable industry practices that are readily identifiable, credible and consistently applied.

The PMP identifies specific administrative and technical procedural documents that the Project Sponsor will develop to implement the policies, practices, and approaches necessary for project success as envisioned and contracted through FTA grants.

Project management concepts are developed initially during the PD phase and should be documented in the PMP. FTA requirements for the PMP are defined in 49 U.S.C. 5327 and 49 CFR 633. [Ref. 2-29] The PMP defines the scope of project implementation starting at least in PD, and the policies for ensuring the sound, risk-informed, and performance-based management and control of all project activities. The PMP should also adhere to grant management requirements in FTA Circular 5010.1D [Ref. 2-30].

FTA requires that Project Sponsors undertaking an MCP must submit a PMP for FTA's review and approval prior to Engineering (see Figure 2-1) and before advancing to subsequent project phases. Although FTA has some discretion in determining which capital projects are considered major, major projects are generally defined to include the construction of a new fixed guideway segment, extension of an existing fixed guideway, or modernization of an existing fixed guideway system. Per 49 U.S.C. 5327, the Project Sponsor's PMP must include as a minimum:

- Adequate recipient staff organization, complete with well-defined reporting relationships, statement of functional relationships, job descriptions, and job qualifications
- A budget covering the project management organization, appropriate consultants, property acquisition, utility relocation, systems demonstration staff, audits, and such miscellaneous payments as the recipient may be prepared to justify
- A construction schedule
- A document control procedure and record-keeping system
- A change order procedure which includes a documented, systematic approach to the handling of construction change orders

- A description of organizational structures, managerial/technical skills, and staffing levels required throughout the construction phase
- Quality control (QC) and quality assurance (QA) programs that define functions, procedures, and responsibilities for construction and for system installation and integration of system components
- Materials testing policies and procedures
- Safety and security management
- Internal plan implementation and reporting requirements
- Criteria and procedures to be used for testing the operational system or its major components
- Periodic updates of the plan, especially related to project budget and project schedule, financing, ridership estimates, and the status of local efforts to enhance ridership where ridership estimates partly depend on the success of those efforts
- The recipient's commitment to make a quarterly submission of project budget and project schedule to the Secretary

The PMP should demonstrate that all phases of the project have been thoroughly considered, giving thought to the methods to be used to execute the project, and the interfaces that will be created among various participants. The PMP should define the objectives of the project, the methods and resources proposed to meet those objectives; the overall risk-informed, performance-based management approach – including the technical and administrative means and methods for project control; and the responsibilities, authorities, and measures to robustly gauge the performance for all parties involved.

Table 2-1 provides an example of a PMP outline. This outline is based on a traditional Design/Bid/Build (D/B/B) procurement approach. The components would be modified under most alternative delivery approaches. The PMP should be a “controlled document”, i.e., each version should be developed and approved under the project document control and configuration management policy and procedures, with distribution of revisions accurately handled to ensure requisite parties have the latest revision. As indicated, many required elements of a PMP will likely be developed as separate documents, referenced in the PMP with descriptive material on guiding policies, authorities, responsibilities, updating, etc. These referenced documents, too, should be controlled documents.

The PMP should recognize the role of FTA in the oversight and independent review of the project. PMOCs are assigned by FTA to MCPs as an extension of the regional office staff to monitor and assess the technical aspects of the project. FTA also has Financial Management Oversight (FMO) contractors available to review issues of finance and accounting related to a Project Sponsor or a project, including specific methods and systems. These resources should be utilized as appropriate by the Project Sponsor's project team.

Table 2-1. Project Management Plan Outline

1. Basis for the Project		
Objectives of the Project		
Project Description		
Name of project sponsor and all partners involved in project development work		
Description of project organization with key personnel and support contractors including safety and security, for Project Development		
An anticipated timeline for completing the project development work within the two-year timeframe specified in MAP-21		
Delete this row		
Evidence of LPA adoption into MPO Long Range Plan		
Evidence of project in TIP, STIP		
Legal Authority to Implement the Project and other Legal Approvals		
PMP Workshop Documentation (if applicable)		
2. Environmental Assessment / Mitigation Plan		
Delineation of NEPA analysis requirements / Project Impact Analysis		
Description of Mitigation Principles		
Plan for Management and Implementation of Mitigation Actions		
3. Design Control Plan		
Description of relationship between forecasted ridership, operating plan and proposed project transit capacity in guideways, stations, support facilities		
Design Criteria for Each Discipline		
Schedule for the development of contract documents (level of development expected at each milestone for design/construction drawings, specifications, general and supplementary conditions of contracts for construction, and the Division 1)		
Design Reviews for Drawings and Specifications		
	Value Engineering Review / Life Cycle Review	
	Coordination Review – Internal to agency and design team; External to third parties, intergovernmental, etc.; Transit-oriented and Joint Dev.	
	Constructability Review	
	Operability and Maintainability Review	
	Other peer or industry reviews	
Design Change and Configuration Control of documents during Design and Construction		
	Change Identification	
	Documentation Procedures	
	Review and approval	
Plan (List and schedule) for third party agreements permits including utilities, real estate, railroads, transit-oriented development/joint development, etc.		
Investigation and Testing Plan		
	Plan/schedule for site surveys, geotechnical and materials investigation before/during design	
	Plan/schedule for geotechnical and materials testing during construction	
4. Project Controls		
Document and Records Controls		
	Description of document organization approach including review, distribution, storage	
	Identification of physical document location	
	Identification of electronic document control system; description of interoperability among management systems	
	Evidence of Document Control Procedures being implemented	
Cost Control Procedures		
	Description of Estimating Methods/Assumptions	
	Final Cost Estimating Methodology Report	
	Procedures for maintaining Baseline Project Cost through:	
		Minimizing schedule delays
4. Project Controls (con't)		
		Contingency Management
		Contracting techniques
		Cost allocation
	Procedures for working with construction contractors to maintain SCC Cost Breakdown of contract sum through construction, at contract closeout.	
Schedule Control Procedures		
	Description of Scheduling Methods and Assumptions	
	Procedures for updating Baseline Project Schedule	
	Procedures for keeping the project on schedule	
Risk Control Procedures		
	Description of risk identification procedures pertaining to project team organization, scope, cost, schedule, quality;	
		Risk identification in project team; drawings; General and Supplementary Conditions; Div. 1, Div. 2 – 48 Technical Specifications
	Risk evaluation / assessment plan and procedures	
	Risk control and management plan and procedures	
	Contingency control and management plan and procedures including establishment of minimum contingency levels at each milestone (contingency drawdown)	
	Role of Insurance	
Dispute / Conflict Resolution Plan (claims avoidance and claims resolution)		
	Plan for Design Phases	
	Plan for Procurement	
	Plan for Construction Phase	
	Plan for Start Up and Revenue Operations	

Table 2-1 Project Management Plan Outline ***(continued)***

5. Project Delivery and Procurement Plan		
Procedures for Procurement (advertising, bidding, awarding of contracts for consultants and construction contractors, procurement for equipment, etc.)		
Procurement Plan and Schedule (indicate project phase, durations for RFP, screening, interviews, selection, board approvals, etc.)		
	Community Outreach Services	
	Information System Services	
	Real Estate Services	
	Project Management Services	
	Design Services	
	Legal Services and other services	
	Construction Management Services	
	Construction Testing and Inspection Services	
	Construction	
		Prelim. Selection of Project Delivery Method (DBB, DB, CMGC etc.) (include rationale for and identification of risks inherent in selected method)
		Final Selection of Project Delivery Method
		Major Contract Packages – Description of Packages and Construction Sequencing
		Procurement of Long Lead Items and Pre-FFGA items or work
		Work by Third Parties such as Utilities, Railroads, Private Sector, etc.
Contracting Strategy for Transit- Oriented Development and Joint Development		
Identification of Disadvantaged Business Enterprises (DBE) Opportunities, Federal DBE, State/Local WBE & MBE, Plans and Goals		
6. Labor Relations and Policies		
Wage Rates and Classifications		
Wage and Hour Requirements		
State and Local Regulations		
No-Strike Agreements		
7. Construction of Fixed Infrastructure – Procedures		
Construction Contract Administration		
Construction Management		
Construction Inspection		
Coordination with Third Parties		
Site Logistics Plan (materials transport and storage; temporary site facilities; maintenance of existing pedestrian ways, transit and traffic operations during construction; protection of existing utilities)		
Processing Shop Drawing, Bulletin, RFIs		
Negotiating and Approving Change Orders and Claims		
Substantial Completion; Final Completion		
8. Start up and Revenue Operations		
Testing Plan		
	Systems	
	Equipment	
	Vehicles	
Closeout Materials (warranties, testing results, O&M manuals, spare parts, etc.)		
Plan for Training of Staff		
9. Sponsor Management Capacity and Capability Documents (MCC)		
Management Capacity and Capability		
10. Quality Assurance / Quality Control Program Plan		
QA/QC Plan		
11. Safety and Security Management Plan		
Safety and Security Management Plan		
12. Real Estate Acquisition and Management Plan		
Real Estate Acquisition Management Plan		
13. Fleet Management Plan		
Fleet Management Plan		

The PMP, while submitted initially prior to entering the Engineering Phase, is intended to be a dynamic document that should be expanded and updated as necessary throughout project implementation. Updates should include, but should not be limited to, project budget, project schedule, financing, ridership estimates, and, where applicable, the status of local efforts to enhance ridership when estimates are contingent upon the success of such efforts. The PMP should be updated, as a minimum, prior to advancing into the Construction phase. FTA suggests that for large multi-segment projects, a program PMP be developed and modified for each phase of each major segment. The modified PMP should reflect the unique characteristics of each segment/phase, such as the exact scope of work and specific resources, e.g., project staff, budget, and schedule.

The PMP should address standards for design, most particularly the policy and management assurance to define and utilize the array of engineering, architectural, safety/security, operations, and maintenance industry standards (and related codes) which are applicable to the project and technologies being considered. The details may often be presented in a separate Design Criteria document that would include detailed descriptions of the project features and succinct definitions of its operational parameters.

The PMP should address the need for environmental reviews and for adhering to the resulting mitigation measures in the design and construction phases. The need to address hazards and threats through formal PHAs and TVAs should also be addressed, as should the potential requirements for developing health and safety plans.

PMP is a useful tool for non-MCPs, e.g., SGR, bus facilities, vehicles, and ITS projects. With or without the development of a PMP, the project management function must be well defined and it must be continuous. The Project Sponsor should have project management policies and procedures and an adequate staff of professionals skilled in but not limited to, project controls, QA/QC, cost estimation, scheduling, procurement, transit operations, safety and security, and public participation. FTA may review these capabilities periodically through its Triennial Review process.

2.2.4 Rail Modernization Planning

Rail transit operators should establish a planning process suited to the specific needs of their transit systems and encourage an institutional environment to guide the modernization of existing facilities in a sound and cost-effective manner.

The planning of rail system modernization projects is best accomplished at the subsystem level for which the following categories are typical:

- Civil structures
- Track structures
- Stations
- Fare collection
- Elevators and escalators
- Railcars
- Traction power
- Electrical distribution
- Ventilation
- Train control
- Communication systems
- Vehicle maintenance and storage facilities and equipment

Recent Changes Related to Rail Modernization

Project Sponsors undertaking rail modernization should familiarize themselves with the national Transit Asset Management (TAM) and State of Good Repair (SGR) grant systems implemented per 49 U.S.C. § 5327. Both are discussed elsewhere in the **Guidelines***, and detail is available at the FTA website.*

Subsystem planning involves assessment of condition, establishing modernization goals and performance specifications, performing economic trade-off analyses involving life cycle costing principles, and developing implementation priorities. Subsystem planning should include safety and security considerations for each category, particularly those that will involve outside construction or whose engineering or design will be influenced by location, public access, or other factors that play a role in safety and security. For example, design of stations, choice of and placement of fare collection systems and/or gates or turnstiles, location of retail establishments, and placement of elevators and escalators all have safety and security ramifications.

Additionally, the need to perform some advanced engineering to support subsystem development may be associated with this process. For example, advanced engineering could involve analysis to determine capacity requirements of individual electrical substations and verification of the economic benefits of replacing remotely supervised electro-mechanical substations with centrally controlled solid state equipment. Planning also should consider the effect of old, obsolete, and unreliable equipment on the performance of the overall transit system. In addition to purely economic benefits, analyses should consider service reliability and system maintainability. Analyses should also consider security during development, construction, and operations, particularly when designing stations, fare collection mechanisms, elevators and escalators, railcars, communications systems, and vehicle maintenance and storage facilities.

An FTA investigation of the processes and techniques used by most of the nation's largest rail transit systems documented elements of the rail modernization planning process that were used, in varying degrees, by the transit planning and operating agencies to prioritize projects for advancement to subsequent phases. These processes and techniques include:

- Prescribing planning/programming requirements
- Establishing centralized planning organization/process
- Establishing goals/objectives
- Establishing quantitative performance goals
- Defining performance measures
- Assessing long-term modernization requirements
- Considering elimination of existing rail lines
- Planning new route(s) to complement existing system
- Establishing life cycle replacement policy
- Defining long-term financing requirements
- Estimating system-wide ridership and capacity requirements
- Developing subsystem plans and implementation priorities
- Performing systems engineering and analysis of alternatives
- Performing economic analyses of projects
- Predicting impact of project on performance measures
- Using a project rating system
- Using a senior management review committee
- Reviewing lessons learned

In addition, hazard and threat analyses may also be required.

2.2.5 Bus Maintenance Facility Planning

While more narrowly defined in scope and impact, bus maintenance facilities, nevertheless, require adequate planning to achieve their objectives in a cost-effective manner.

Recognizing that planning for a new or modified bus maintenance facility requires engineering and economic analyses to support effective decision-making, the following ten-step process has been recommended:

(1) Adopt a design year fleet size
(2) Determine space adequacy
(3) Determine structural adequacy
(4) Determine alternatives (rehabilitation, new construction, expansion)
(5) Sketch plans for adequately sized facilities
(6) Estimate construction costs
(7) Estimate cost of changes in non-revenue operating costs for each new site
(8) Analyze facility optimization, locations, and route allocations (for multiple facility systems only)
(9) Analyze engineering economics
(10) Assess environmental issues

The above process should be fully documented in the Project Sponsor's Bus Fleet Management Plan (BFMP).

An assessment of environmental impacts may also be required. See Section 2.2.7 for a discussion of environmental issues.

The FTA Construction Project Management Handbook was developed to help guide Project Sponsors in the development and construction of such facilities.

2.2.6 Project Risk Analysis and Procurement Planning

As early as the PD Phase, alternative project delivery methods should be considered within the context of project risk analysis and procurement planning. The window of opportunity to select some methods will close as the project moves through various stages of its development (Table 2-2, below).

Given the nature of the project to be implemented, the most important impacting factors (agency related parameters, legal parameters, and lifecycle issues), and the experience of the Project Sponsor, the Project Sponsor should select a project delivery and contracting approach that minimizes project risks and provides the greatest likelihood of implementation success. Success can be measured in terms of minimizing costs (and cost overruns) and schedule (and schedule slippages).

Table 2-2. Timing of Project Delivery Method Selection

Project Delivery Method	At the End of Project Development	At the End of Engineering	Construction and Procurement
D/B/B	■	○	NF
CMR	■	ND	NF
D/B	■	ND	NF
D/B/O/M	■	ND	NF
PPP	■	NF	NF

Legend
■ = Desirable
○ = Feasible
ND = Not Desirable
NF = Not Feasible

(Source: TCRP Report 131, "A Guidebook for the Evaluation of Project Delivery Methods")
[Ref. 2-31]

The general philosophy is that risks should be assigned to the party best able to manage them. There are also tools available to manage project risk factors in terms of contract provisions that can provide a variety of incentives and disincentives. Project delivery and contracting approaches include, but are not limited to, the following:

- Design/Bid/Build (D/B/B) – The D/B/B approach is the traditional project delivery method and is characterized by the sequential process of first designing then selecting the construction contractors. Frequently there are multiple prime contractors for both design and construction. The owner is responsible for the details of design and warrants the quality of the construction design documents to the construction contractor. All financing responsibility rests with the Project Sponsor. This method is historically the most common and familiar form of project delivery. The Project Sponsor manages the entire process including the multiple interfaces between contracts and is responsible for O&M of the resulting system. The designer(s) is (are) typically selected on a qualifications basis, then terms are negotiated and 100 percent design plans are produced.

  These plans along with detailed specifications are then put out through a competitive bidding process to the contractor community and are typically awarded to the "lowest-price responsive and responsible bidder". Payments to contractors are made based on unit prices against quantities constructed or on percentage complete. Risks beyond the control of the contractor, such as severe weather, unforeseen underground conditions, etc. are usually borne by the Project Sponsor; design risk is usually contractually transferred to the designer, and construction-related risk, such as quality of workmanship or adherence to schedule or bid cost are borne by the contractor.

D/B/B projects can also be awarded on a negotiated basis and/or a best-value basis. It must be noted, however, that D/B/B projects awarded in either of those manners usually requires prior FTA approval. They may not be used if they are in violation of local contracting laws.

- Design/Build (D/B) – D/B is a delivery method where the Project Sponsor contracts with a single entity to provide both design and construction services. However, for complex projects such as fixed-guideway transit systems multiple D/B contracts may be used for distinctive elements such as civil, vehicles and systems. Financing responsibility rests with the Project Sponsor. The D/B contractor may be a single firm, a joint venture, or most commonly, a general contractor and architect/engineer team, but it still takes full responsibility for the design. The scope of activities in the D/B contract may include permitting, utility relocations and ROW acquisition. While D/B can be selected solely on lowest price, it is normally a fixed fee, best-value selection based on a combination of elements like price, schedule, and technical approach to take maximum value from innovation opportunities. Many of the NS projects use this approach including the Washington WMATA Largo Metrorail, Minneapolis Hiawatha light rail transit (LRT), and Denver Regional Transportation District Southeast Corridor LRT. The Southeast Corridor was delivered as part of a $1.7 billion D/B contract that included both LRT and highway improvements and reduced the delivery schedule by as much as 22 months.

  Common methods for procuring D/B contracts are the one-step and the two-step processes. The one-step process provides for competitive evaluation of technical proposals, with the contract award decision based on best value to the owner agency. The determination of best value is based on a combination of technical merit and price. The two-step process separates the technical proposal from the price. This method typically uses request for qualifications (RFQ)/request for proposal (RFP) procedures rather than D/B/B invitation for bid procedures. There are a number of variations on the D/B process, but all involve three major components:

  (1) The Project Sponsor develops an RFQ/RFP that describes essential project requirements in performance terms.
  (2) Proposals are evaluated.
  (3) With evaluation complete, the Project Sponsor must engage in some process that leads to contract award for both design and construction services. The D/B entity is liable for all design (after the Project Sponsor provides design documentation and at completion of the environmental process and 30 percent design completion) and construction costs and must usually provide a firm, fixed price in its proposal together with a firm schedule.

The primary advantages of D/B may include time savings from combining design and construction phases and increased flexibility on construction sequencing, improved risk transfer and improved quality as well as cost savings from shorter and sooner delivery times, potential for innovative cost saving approaches and fewer change orders. The trade-offs relate to less direct control of the design process and specific construction methodologies along with a longer procurement process and the need to create performance specifications and a D/B agreement.

- Design/Build/Operate/Maintain (D/B/O/M) – An expansion of D/B to also give the D/B contractor responsibility for O&M of the completed transit capital project, usually for a period of 5 to 15 years. While all of the D/B elements discussed above apply, two additional distinctive elements factor into D/B/O/M. The first is that the requirement to maintain the system should incentivize the D/B/O/M contractor to have particular emphasis on both quality and life-cycle costs as well as to complete the project as quickly as possible. This approach can also result in improved operating efficiency. However, it is important that the appropriate contractual relationship exists between the D/B entity and the O&M contractor to assure that synergy is achieved. The second is that in addition to design and construction performance requirements, it is also necessary to develop O&M performance requirements. D/B/O/M approaches are more difficult to use at public agencies that have existing labor agreements unless it is for a new type of service (for example, commuter rail, if existing service is bus and LRT). The Hudson-Bergen LRT D/B/O/M experience points out the importance of incorporating the right performance standards. New Jersey Transit discovered that, although the consortium received a penalty or bonus for on-time performance, the lack of incentives for station cleanliness or customer notification failed to produce the desired level of positive customer experience.

- Concession or D/B/O/M/Finance (DBOM/F) – This approach builds on all of the D/B/O/M discussion but expands the private party responsibility to cover project financing responsibilities, possibly including the implementation of joint development. Concession contracts may also be referred to as Public/Private Partnerships or PPPs. Even with the private party involved in the financing, the title for the project will be held by the public sponsor. A DBOM/F can be valuable if the public owner has limits on its total bonded indebtedness or needs a longer term to finance the project. The contracting party for a DBOM/F is more likely to be a concessionaire, a company that has a portfolio of projects financed with a combination of equity and bank debt or taxable bonds. In addition to the provisions in a DBOM, the procurement and contractual documents must also address financing and terms under which the facility will be handed back to the Project Sponsor at the end of the lease.

For transit projects, the long-term lease agreement will most likely have a term of 30–50 years or more, with a payment structure known as an Availability Payment. Availability Payment means that the private party takes responsibility for financing the construction and then starts to receive annual payments after the project is accepted and available for use by the public owner. This provides another advantage to the Project Sponsor, as it delays the start of the repayment until after completion of construction. As in D/B/O/M agreements, the full availability payment will not be received unless agreed performance standards are achieved.

In certain circumstances, a private entity may be willing to take up-front development risks for a transit project. As part of an unsolicited proposal, Bechtel Enterprise provided approximately $28 million of initial project funding for the Portland MAX Airport Extension in exchange for being repaid by the rights to develop a 120-acre parcel adjacent to the airport. This contribution funded 23 percent of the capital expenses and the development was targeted to also increase use of the extension. On the construction alone, it is estimated that over three years in time and $10-15 million were saved by this approach.

- Construction Manager at Risk (CMR) or Construction Manager/General Contractor (CM/GC) – Under this approach the Project Sponsor can retain full control of the design but also engage the construction contractor early in the process to address elements such as constructability reviews, cost estimating, and scheduling. When an acceptable level of engineering is achieved, the parties quickly negotiate the price and begin construction. The owner/Project Sponsor chooses both the designer and the CM/CG contractor based on qualifications. During the initial phase, the contractor is paid for its services on a professional services basis. The second phase of the contractor's services is negotiated lump sum or guaranteed maximum price with incentives for savings agreed to after final design of the work is complete. If the parties cannot agree on a price, the contracting method could convert to D/B/B. Alternatively, the CM/GC could manage the contract for a fee, controlling general conditions and holding the construction contracts in expectation of direct reimbursement from the owner. The contractor assumes responsibility for the entire construction package with a dual role as construction manager for all project work and general contractor.

  The qualifications approach eliminates the lengthier request for proposals process and achieves price competition through subcontractor bidding. CM/GC does not eliminate design and construction interface issues as the owner still retains responsibility for the design and controls the process similar to a D/B/B. CM/GC may be a challenging approach for some Project Sponsors to manage and receive the anticipated value since it is a hybrid approach and involves negotiating a sole source construction price.

A number of additional variations exist across the globe such as Build-Own-Operate (BOO), Build-Transfer-Operate (BTO) or Build-Operate-Transfer (BOT) where the private entity could be responsible for D/B and operation of a project, and retain full ownership (BOO), transfer ownership to the public agency prior to assuming operating responsibility (BTO) or after performing operations for a period of time, e.g., 20 years (BTO). These variations are rare in the United States, where, due to tort liability risks, title is almost always held by the public owner.

The rationale for early decisions on the overall contracting approach is that it is essential to establish various roles and responsibilities to avoid duplication of efforts or schedule delay. The contracting approach will directly influence the design scope of work, which, for instance, would need to be different for turnkey than for D/B/B. In addition, the use of an alternative delivery approach will influence the means and methods for choosing the entire consultant contracting strategy. The Project Sponsor should recognize that a large fixed guideway transit project can involve combinations of contracting approaches to implement the overall project. The Bay Area Rapid Transit (BART) San Francisco International Airport (SFO) Extension, for instance, included a traditional D/B/B contract for site preparation and utility relocation plus four separate D/B contracts that included one contract for line, trackwork, and systems and three for station and parking facilities.

2.2.7 Environmental Planning

The major activities in the transportation planning process, which require early consideration and substantive completion, are functional analysis, alternative studies, site selection, hazardous material and geotechnical studies, utility and third-party coordination, compliance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (URA) for real estate acquisitions, and meeting relevant NEPA regulations related to air quality, and requirements for historical preservation and protection of public lands. [Ref. 2-32 and 2-33]. In addition, in NAAs or in maintenance areas, transportation plans must contain sufficient detail to allow conformity findings as defined by EPA General Conformity Regulations [Ref. 2-34].

Environmental Site Assessments (ESAs) are investigative programs that identify soil, groundwater, surface water, or building contamination that are present on a construction site. Discovery of hazardous materials at a site can prove costly in terms of removal activities and delays, and thus the presence of these materials should be identified as early as possible.

Three classes of actions have been defined, each with separate requirements to guide planning to address their potential impacts. They are:

- Class 1 actions normally have a significant impact on the environment and thus require an Environmental Impact Statement (EIS). Major projects, both NS and SGR projects, fall into this category.
- Class 2 actions normally do not entail a significant impact on the environment, and therefore do not require an EIS or an EA. These projects are known as Categorical Exclusions (CE) and typically include rail or bus modernization projects constructed within the bounds of the existing ROW, or are new bus facilities constructed in industrially zoned areas without major impacts on traffic.
- Class 3 actions are those in which the significance of the impacts on the environment are not clearly established and for which an EA is prepared to determine the probable impacts. If significant impacts are uncovered, an EIS will be required; otherwise, a Finding of No Significant Impact (FONSI) determination will conclude the NEPA process.

Within the NEPA process (Figure 2-2), other applicable environmental laws and regulations are complied with, including those related to historic preservation and protection of public lands.

Recent Changes to the Transportation Planning Process

The Project Sponsor should be aware there are opportunities to accelerate project delivery, such as through early acquisition of property, using planning studies or products in the NEPA process, and programmatic mitigation plans, as described in MAP-21 sections 1302 and 1310.

The early acquisition of property for ROW is possible prior to completion of the NEPA process provided certain findings are made, including a finding that the acquisition will not limit the consideration of alternatives in the NEPA process. This authority can only be used for acquisitions that are negotiated "without the threat of condemnation."

FTA authorized the planning-NEPA linkage through its statewide and metropolitan planning regulations and has allowed a wide range of decisions and analyses to be adopted in the NEPA process, including decisions on purpose and need and the range of alternatives to be considered. Using or adopting planning products in the NEPA process is allowed if it has been approved by the state, all local and tribal governments where the project is located, and by any relevant MPO.

States and MPOs can develop programmatic mitigation plans as part of the statewide or metropolitan transportation planning process. Programmatic mitigation plans can be developed on a regional, ecosystem, watershed, or statewide scale. These and can encompass multiple environmental resources within a defined geographic area or focus on a specific resource, such as aquatic resources, parkland, or wildlife habitat. It should be understood the recommendations in a programmatic mitigation plan are not binding. A Federal agency may consider that plan in determining mitigation for a project when carrying out its responsibilities under NEPA, but it is not required.

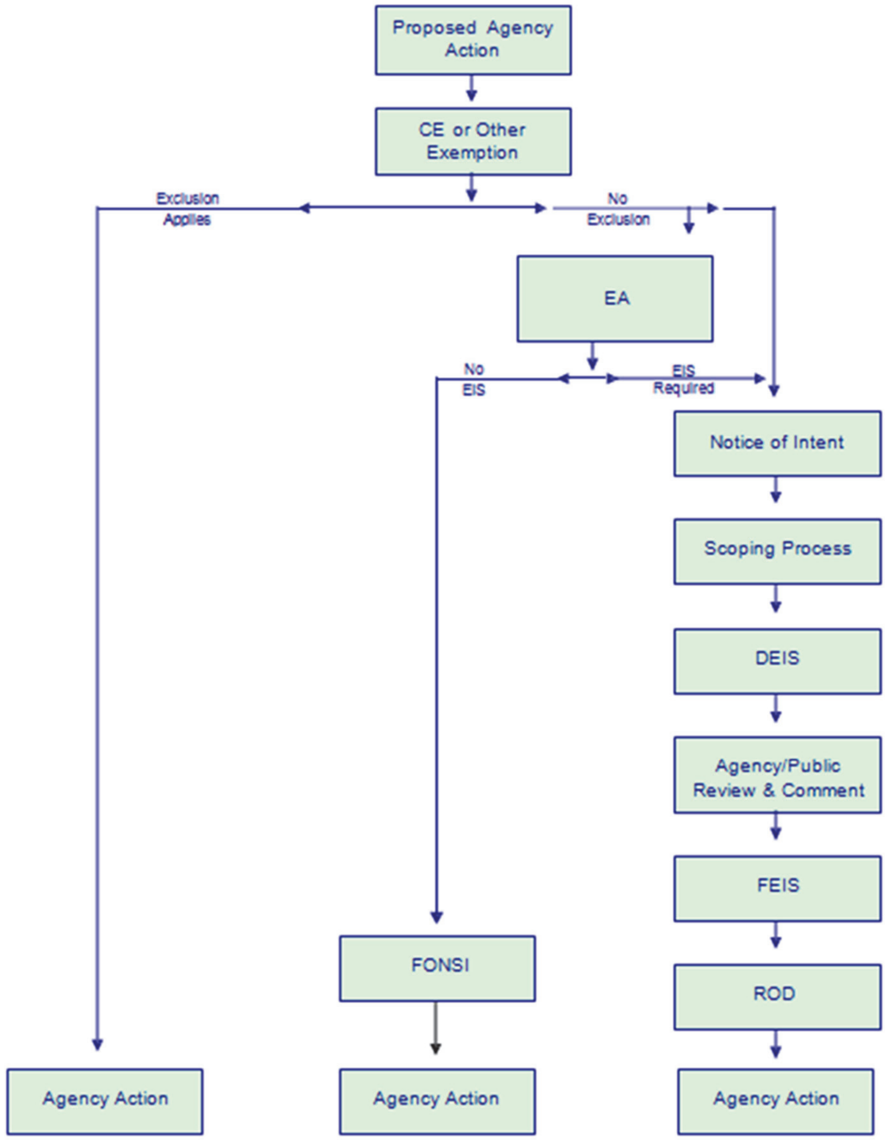


Figure 2-2 The NEPA Process

The Project Sponsor should determine early in the planning process whether or not there are any environmental issues. Coordination with FTA planning and environmental specialists to develop and carry out the scoping process, outlined in Section 1501.7 of the Council on Environmental Quality (CEQ) Regulations, before the NEPA process formally begins, ensures that all significant environmental issues are addressed.

MAP-21 requires that NS Project Sponsors complete the PD Phase within two years, which may be challenging for proposed projects that have significant environmental impacts, complicated financial arrangements, or complex engineering and design elements. Therefore, FTA encourages Project Sponsors to perform whatever work they feel is necessary prior to requesting entry into PD to facilitate their ability to complete PD for a proposed NS project within the two-year timeframe. For example, prior to requesting entry into PD, Project Sponsors may wish to conduct early planning work and initiate the environmental review process under NEPA including, where appropriate, early scoping.

MAP-21 requires that during PD, and not later than two years after the date the project enters PD, the following activities be completed:

- The Project Sponsor must select an LPA.
- The Project Sponsor must get the LPA adopted into the fiscally constrained metropolitan transportation plan.
- The environmental review process required under NEPA must be completed as signified by a final FTA environmental decision (e.g., categorical exclusion, finding of no significant impact, combined FEIS/ROD, or ROD) covering all aspects of the project proposed for FTA funding.
- The Project Sponsor must develop sufficient information for FTA to develop a project rating [Ref. 2-35].

2.2.7.1 *Scoping*

Scoping is necessary to:

- *Identify the affected public and agency concerns.*
- *Facilitate an efficient NEPA process.*
- *Define the issues and alternatives that will be examined.*
- *Save time in the overall NEPA compliance process.*

Scoping is a public process designed to identify the major environmental issues and concerns associated with a proposed major Federal action at the beginning of NEPA compliance. Perhaps of even more importance, scoping provides the initial opportunity for building confidence and trust between project proponents and project stakeholders.

Stakeholders involved in the NEPA process may include state and local government agencies, tribal governments, non-governmental organizations or groups, and affected citizens.

The scoping process is usually the first opportunity for communication between the proponents of an action and the public. Thus, the initiation of the scoping process can be a daunting experience for both parties; proponent agencies are often unaware of how their proposed actions will be perceived and the public is often concerned over unknown details and potential impacts of the project. Therefore, well-developed scoping process initiatives are vital to help agencies obtain information and identify specific issues of public importance and for the public to develop an understanding of the proposed actions and trust of the proponents. The fostering of an effective relationship between the project proponents and the public coupled with a shared understanding of critical issues and concerns associated with the proposed action will greatly contribute to effective and efficient project development.

It is important that scoping take place early in the NEPA process to ensure that important issues are identified and that applicable commitment can be attributed to study of those issues. Successful scoping initiatives also provide for the identification of those issues determined to be insignificant. This understanding at an early stage allows the federal agency to focus its efforts on the most important issues, avoiding the need to complete an exhaustive analysis of relatively less-critical environmental concerns.

2.2.7.2 *FTA's Expanded Use for Categorical Exclusions*

The FTA categorical exclusions (CEs) at 23 CFR 771.118 are tailored specifically to transit projects and provide for a straightforward and efficient environmental review process. Per the CEQ's "Establishing, Applying, and Revising Categorical Exclusions under the National Environmental Policy Act" guidance of December 2010, the CEs in 23 CFR section 771.118 are presented as general categories that include limitations and provide a list of actions that are typically categorically excluded. CEs added to section 771.118 pursuant to MAP-21 do not follow the same format because they were created pursuant to specific statutory criteria [Ref. 2-36].

The list of CEs in section 771.118(c) focuses on actions most applicable to FTA. It is FTA's responsibility to determine whether the action described by the grant applicant falls within the CE category (i.e., the action meets all conditions listed in the CE), whether the action is impermissibly segmented from a larger project, and whether there are unusual circumstances – for example, substantial controversy on environmental grounds, significant impact to properties protected by Section 4(f) of the U.S. DOT Act or Section 106 of the National Historic Preservation Act – that would make a CE determination inappropriate [Ref. 2-36].

Grant applicants should include sufficient information for FTA to make a CE determination. A description of the project in the grant application, as well as maps or figures will normally be sufficient for FTA to determine whether the CE applies. Other applicable environmental requirements must be met regardless of the applicability of the CE under NEPA, but compliance with other environmental requirements does not elevate an action that otherwise is categorically excluded under section 771.118(c) to section 771.118(d) [Ref. 2-36].

Section 771.118(d), which is an open-ended categorical exclusion authority, lists example actions and requires documentation to verify the application of a CE is appropriate (i.e., the action meets the criteria established in Sections 771.118(a) and (b)). The list of examples is particularly helpful for those actions that do not meet the conditions of CEs found in section 771.118(c) [Ref. 2-36].

A CE must capture the entire action, which includes all connected actions (CEQ, "Final Guidance on Establishing, Applying, and Revising Categorical Exclusions under NEPA," 75 FR 75628, 75632, December 6, 2010). The requirement that a project demonstrates independent utility, connects logical termini, and does not restrict consideration of alternatives reflects FTA's test for determining the full scope of a project for NEPA review purposes and avoiding impermissible segmentation. This does not prohibit the construction of a transportation facility in phases, so long as the project scope reviewed under NEPA meets the test described above. Typically, the documentation expectations described above will be sufficient to demonstrate impermissible segmentation is not occurring, but in some instances, additional information may be needed [Ref. 2-36].

2.2.7.3 *Section 4(f) of the U.S. Department of Transportation Act of 1966*

Section 4(f) of the Department of Transportation Act of 1966, 49 U.S.C. 303(c), requires that the proposed use of land from any publicly-owned public park, recreation area, wildlife and/or waterfowl refuge, or any significant historic site may not be approved as part of a federally-funded or approved proposed action unless:

- FTA determines that there is no feasible and prudent avoidance alternative to the use of land from the property, and the action includes all possible planning to minimize harm to the property resulting from such use; or
- FTA determines that the use of the Section 4(f) properties, including any measures to minimize harm (such as avoidance, minimization, mitigation, or enhancements measures) committed to by the applicant, would have a *de minimis* impact on the property.

A “use” of property afforded consideration and protection under Section 4(f) occurs:

- When land is permanently incorporated into a transportation facility;
- When there is a temporary occupancy of land that is adverse in terms of the statute's preservation purpose; that is, when one of the following criteria for temporary occupancy are not met:
  - The duration of the occupancy must be less than the time needed for the construction of the proposed action, and no change of ownership occurs.
  - Both the nature and magnitude of the changes to the Section 4(f) property are minimal.
  - No permanent adverse physical changes, or interference with activities or purposes of the resources on a temporary or permanent basis, are anticipated.
  - The land must be returned to a condition that is at least as good as existed prior to the proposed action. A documented agreement of the Federal, State, or local officials having jurisdiction over the land regarding the above conditions is effectuated.
- When there is a constructive use of a Section 4(f) property. A constructive use occurs when the proposed action does not incorporate land from a Section 4(f) property, but the proposed action's proximity impacts are so severe that the protected activities, features, or attributes that qualify the property for protection under Section 4(f) are substantially impaired. Examples of a constructive use are:
  - The noise level increase from the proposed action substantially interferes with the use and enjoyment of a Section 4(f) resource (e.g., hearing performances at an outdoor amphitheater or interrupting a quiet setting).
  - The proximity of the proposed action substantially impairs the aesthetic quality of a resource where these aesthetic qualities are considered important contributing elements to the value of a resource (e.g., obstructing or eliminating the primary views of an architecturally significant building).
  - A restriction on access diminishes the utility of a resource.

  - A vibration impact from the operation of a proposed action impairs the use of a resource or affects the structural integrity of a historic building or impairs its utility.
  - The proposed action results in an intrusion into an ecological setting that diminishes the value of a wildlife or waterfowl refuge adjacent to the proposed action.

A feasible and prudent avoidance alternative avoids using Section 4(f) property and does not cause other severe problems of a magnitude that substantially outweighs the importance of protecting the Section 4(f) property. In assessing the importance of protecting the Section 4(f) property, it is appropriate to consider the relative value of the resource to the preservation purpose of the statute. The preservation purpose of Section 4(f) states: “It is the policy of the United States Government that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites [Ref. 2-37].

An alternative is not feasible if it cannot be built as a matter of sound engineering judgment.

An alternative is not prudent if one of more of the following is true:

- It compromises the proposed action to a degree that it is unreasonable to proceed with the proposed action in light of its stated purpose and need.
- It results in unacceptable safety or operational problems.
- It causes severe social, economic, or environmental impacts even after reasonable mitigation; severe disruption to established communities; severe disproportionate impacts to minority or low-income populations; or severe impacts to environmental resources protected under other Federal statutes.
- It results in additional construction, maintenance, or operational costs of an extraordinary magnitude.
- It causes other unique problems or unusual factors.
- It involves multiple factors above that while individually minor, cumulatively cause unique problems or impacts of extraordinary magnitude.

All possible planning means that all reasonable measures identified in the Section 4(f) evaluation to minimize harm or mitigate for adverse impacts and effects must be included in the proposed action. For public parks, recreation areas, and wildlife and waterfowl refuges, the measures may include (but are not limited to) design modifications or design goals; replacement of land or facilities of comparable value and function; or monetary compensation to enhance the remaining property or to mitigate the adverse impacts of the proposed action in other ways.

For historic sites, the measures normally serve to preserve the historic activities, features, or attributes of the site as agreed by the FTA and the official(s) with jurisdiction over the Section 4(f) resource in accordance with the consultation process under 36 CFR Part 800.

In evaluating the reasonableness of measures to minimize harm, the FTA would consider the preservation purpose of the statute and:

- The views of the official(s) with jurisdiction over the Section 4(f) property;
- Whether the cost of the measures is a reasonable public expenditure in light of the adverse impacts of the proposed action on the Section 4(f) property and the benefits of the measure to the property; and
- Any impacts or benefits of the measures to communities or environmental resources outside of the Section 4(f) property.

De minimis impacts to Section 4(f) resources are those impacts that would have no adverse impact on the protected resource. For parks, *de minimis* impacts are defined as those that do not adversely affect the activities, features, and attributes of the resource. The official with jurisdiction over the park or property must concur that the proposed action would not adversely affect the resource. For historic properties, a *de minimis* impact finding may be made if a “no historic properties affected” or “no adverse effect” determination is made through the Section 106 process and concurred upon by the SHPO.

After consideration of impact avoidance, minimization, and mitigation or enhancement measures, the FTA may determine that use of a Section 4(f) property results in a *de minimis* impact. In such cases, an analysis of avoidance alternatives is not required and the Section 4(f) process is complete. A *de minimis* finding cannot be made if there is a “constructive” use of a Section 4(f) property.

The compliance process typically has three steps for projects that may have an effect on Section 4(f) lands:

- Determining Significance. For a property to be deemed significant, it must play an important role in meeting the objectives of a community in terms of the availability and functions of recreation, park, or wildlife and waterfowl refuge areas. Significance is determined through consultation with the Federal, state, or local officials having jurisdiction over the property. Once a property’s significance has been determined, Section 4(f) prohibits both the actual taking of land from the protected property and constructive use of the property – where a project’s proximity to the Section 4(f) resource substantially impairs the normal use of the land.
- Developing Alternatives. Parklands are to be protected unless unusual factors or unique problems are present, or the cost, environmental impacts, or community disruption resulting from proposed alternatives are particularly large. In evaluating an alternative, one must consider whether the alternative uses Section 4(f) property, whether it is prudent and feasible, and to what extent it harms the resource. If several alternatives include the use of land from a Section 4(f) resource, the alternative which is prudent and feasible and that has the least overall impact on the resource, including mitigation measures, must be selected.
- Section 4(f) Evaluation. Whenever Section 4(f) property is used for a project, documentation must be prepared that demonstrates that there are unique problems or unusual factors involved in the use of non-Section 4(f) alternatives, or

that the costs and social, economic, and environmental impacts, or community disruption resulting from the alternatives are particularly large. The evaluation must contain the following information:

- A description of the proposed action.
- A description of the resource.
- The impacts of each alternative on the resource.
- Alternatives to avoid using the resource.
- Measures to minimize harm.
- Coordination with the agency having jurisdiction over the Section 4(f) property.

Although the Section 4(f) implementing regulation at 23 CFR Part 774 is a joint FHWA-FTA regulation, FHWA's Section 4(f) Policy Paper is officially an FHWA-only endeavor. The FHWA approved revision to its Section 4(f) Policy Paper in July of 2012. The Section 4(f) Policy Paper reflects what FHWA has learned over the years in implementing Section 4(f) for its programs. Although the examples used to illustrate the Section 4(f) policies presented in the paper tend to involve highway projects, equivalent Section 4(f) issues can easily be imagined for transit projects, and the policy presented in the highway example can usually be applied. Moreover, FTA commented on several drafts of the paper during its development, and FTA comments are generally reflected in the paper's final version [2-38].

FTA recommends that the July 2012 FHWA Section 4(f) Policy Paper be used as FTA guidance on Section 4(f) matters, and the policies and procedures described in the paper be followed to the extent they apply to projects proposed for FTA funding [2-38].
In addition, note that FHWA incorporated the substance of the joint FHWA-FTA "Guidance of Determining *De minimis* Impacts to Section 4(f) Resources" (December 2005) into the revised Section 4(f) Policy Paper and declared the 2005 guidance to be superseded by the 2012 paper. In the same way, FTA should look to the Section 4(f) regulation and the July 2012 FHWA Section 4(f) Policy Paper for guidance on implementing the *de minimis* provision of Section 4(f) [2-38].

2.2.7.4 *The National Historic Preservation Act of 1966*

Congress enacted the National Historic Preservation Act (NHPA) in 1966, mandating that Federal decision makers consider historic properties during project planning. Section 106 of the NHPA requires Federal agencies to take into account the effects of undertakings they carry out, assist, fund, or permit on historic properties and to provide the ACHP a reasonable opportunity to comment on such undertakings [2-39].

Federal agencies meet this requirement by completing the Section 106 process set forth in the implementing regulations, "Protection of Historic Properties," 36 CFR. Part 800. The goal of the Section 106 process is to identify and to consider historic properties that might be affected by an undertaking and to attempt to resolve any adverse effects through consultation. The process provides for participation by SHPO, THPO, tribal, state, and local governments, Indian tribes and Native Hawaiian organizations, applicants for Federal assistance, permits, or licenses, representatives from interested organizations, private citizens, and the public. Federal agencies and consulting parties strive to reach agreement on measures to avoid, minimize, and mitigate adverse effects on historic properties and to find a balance between project goals and preservation objectives [2-39].

The CEQ has developed a handbook for integrating processes for complying with NEPA and NHPA Section 106; these processes include the following:

- Begin integration of NEPA and Section 106 processes early.
- Educate stakeholders on the benefits of integrating, through coordination or substitution, the NEPA and Section 106 processes.
- Develop comprehensive planning schedules and tracking mechanisms for the NEPA and Section 106 processes to keep them synchronized.
- Develop comprehensive communication plans that meet agency outreach and consultation requirements to maximize opportunities for public and consulting party involvement and minimize duplication of effort by agency staff. Plans should specify whether the agency will use coordination or substitution.
- Use NEPA documents to facilitate Section 106 consultation, and use Section 106 to inform the development and selection of alternatives in NEPA documents.
- Develop an integrated strategy to accomplish specialized studies to provide information and analysis needed under NEPA and Section 106.
- Complete Section 106 and the appropriate NEPA review (CE, EA, or EIS) before issuing a final agency decision [2-39].

2.2.7.5 *FTA's Environmental Justice Policy Guidance*

The FTA provides guidance to incorporate environmental justice (EJ) principles into plans, projects, and activities that receive funding from FTA in Circular 4703.1. The guiding environmental justice principles followed by FTA are:

- To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.
- To ensure the full and fair participation by all potentially affected communities in the transportation decision –making process.
- To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations [Ref. 2-40].

FTA provides assistant to integrate the principles of environmental justice into the decision-making process. It provides recommendations on (1) how to fully engage EJ populations into the decision-making process, (2) how to determine whether EJ populations would be subjected to disproportionately high and adverse human health or environmental effects of a project, policy, or activity, and (3) how to avoid, minimize, and mitigate these effects [Ref. 2-40].

A key component of EJ is engaging EJ populations as part of the planning process. The public involvement plan should incorporate outreach techniques designed to encourage meaningful participation from EJ populations. If the long-range plan, Transportation Improvement Program, or Statewide Transportation Improvement Plan is estimated to have disproportionately high and adverse human health or environmental effects on EJ populations, early engagement hay help to avoid, minimize, or mitigate the impacts [Ref. 2-40].

2.2.7.6 *MAP-21 and Changes to the Environmental Review Process*

Many provisions in MAP-21 relate to accelerating project delivery; for transit agencies, these changes are significant, as they promote increased flexibility, may potentially shorten the review process, and promote and reward innovation. Some of the most notable provisions are:

- Section 1305: Modifications to the Environmental Review Process

  Section 1305 of MAP-21 amend the Section 6002 environmental review process under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in several ways. These include:

  - Clarifying that requirements established in Section 6002 can be met through programmatic approaches, and directing the U.S. DOT to issue regulations allowing “the use of programmatic approaches to conduct environmental reviews.
  - Allowing the DOT to designate a single modal agency to act as the lead for DOT on a project when a project requires approval of two or more modal agencies.
  - Clarifying that participating agencies (not just the lead agencies) are bound by the requirements in 23 U.S.C. 139.
  - Strengthening the requirement for concurrent compliance with other laws (i.e., laws other than NEPA), and applying this requirement to “each participating agency and cooperating agency,” whereas previously it applied to “Federal agencies”.
  - Allowing the “project initiation notice” requirement to be met by submitting a draft Notice of Intent to FHWA/FTA for publication in the Federal Register.
  - Requiring the lead agencies to obtain “concurrence” of all participating agencies in the project schedule, if the schedule is included in a coordination plan adopted under 23 U.S.C. 139. Previously, only “consultation” was required. Lead agencies are not required to include a schedule in a coordination plan [2-41].

- Section 1308: Statute of Limitations

  Section 1308 of MAP-21 amends the statute of limitations in 23 U.S.C. 139, which was first enacted as part of SAFETEA-LU. Under SAFETEA-LU, the time period for filing lawsuits was set at 180 days. In MAP-21, it has been shortened to 150 days [Ref. 2-41].

- Section 1309: Technical Assistance to Complete Ongoing EISs in Four Years

  Section 1309 of MAP-21 allows USDOT to provide technical assistance to assist in completing an EIS within four years following initiation of the NEPA process. This program is open to current EISs; it requires adoption of a schedule that allows for completion within four years from initiation of the study [Ref. 2-41].
- Section 1319: Condensed FEIS and Combined FEIS/ROD

  Section 1319 of MAP-21 includes two provisions that are intended to shorten the time needed to complete an FEIS and ROD.

  “Errata Pages” Format for FEIS
  Section 1319(a) clarifies that the lead agency can issue an FEIS that consists of errata pages – rather than a complete, stand-alone document – if the agency received only “minor comments” on the DEIS.

  This flexibility existed under the CEQ regulations even before the enactment of MAP-21. Section 1319(a) confirms that this format is acceptable. It also requires that errata pages “(1) cite the sources, authorities, or reasons that support the position of the agency” and “(2) if appropriate, indicate the circumstances that would trigger agency reappraisal or further response.”

  Combined FEIS and ROD
  Prior to MAP-21, FTA and FHWA were required by their own regulations and the CEQ regulations to provide a waiting period of at least 30 days between publication of the FEIS and issuance of the ROD. Section 1319(b) of MAP-21 overrode that requirement. It directs the lead agency to issue the FEIS and ROD as a single document “to the maximum extent practicable,” unless one of the following conditions is met:

  - The FEIS makes “substantial changes to the proposed action that are relevant to environmental or safety concerns” or
  - “There are significant new circumstances or information relevant to environmental concerns and that bear on the proposed action or the impacts of the proposed action.” [Ref. 2-41]

- Section 1320: Early Coordination Activities

  Section 1320 defines “early coordination activities” to include:

  - Technical assistance on identifying potential impacts and mitigation issues in an integrated fashion.
  - The potential appropriateness of using planning products and decisions in later environmental reviews.

- The identification and elimination from detailed study in the environmental review process of the issues that are not significant or that have been covered by prior environmental reviews.
- The identification of other environmental review and consultation requirements so that the lead and cooperating agencies may prepare, as appropriate, other required analyses and studies concurrently with planning activities.
- The identification by agencies with jurisdiction over any permits related to the project of any and all relevant information that will reasonably be required for the project.
- The reduction of duplication between requirements under NEPA and State and local planning and environmental review requirements, unless the agencies are specifically barred from doing so by applicable law.
- Timelines for the completion of agency actions during the planning and environmental review processes.
- Other appropriate factors [Ref. 2-41].

2.2.7.7 *FTA Guidance on Corridor Preservation*

MAP-21 amended Federal transit law by adding a new provision at 49 U.S.C. § 5323(q) that allows FTA, under certain conditions, to assist in the acquisition of ROW before the completion of the environmental review process under NEPA for any transit project that eventually will use that ROW. The new provision, effective on October 1, 2012, states:

> *(q) CORRIDOR PRESERVATION.—*
> *(1) IN GENERAL.—The Secretary may assist a recipient in acquiring right-of-way before the completion of the environmental reviews for any project that may use the right-of-way if the acquisition is otherwise permitted under Federal law. The Secretary may establish restrictions on such an acquisition as the Secretary determines to be necessary and appropriate.*
> *(2) ENVIRONMENTAL REVIEWS.—Right-of-way acquired under this subsection may not be developed in anticipation of the project until all required environmental reviews for the project have been completed.*

Prior to October 1, 2012, FTA only allowed corridor preservation of pre-existing railroad ROW for a future transit project prior to completion of the environmental review process for that project, pursuant to the former 49 U.S.C. § 5324(c). Section 20016 of MAP-21 created a substantially similar provision in 49 U.S.C. § 5323(q), but removed the word "railroad."

MAP-21 did not, however, change the prohibition on the acquisition of real property that is not "right-of-way" prior to the completion of the environmental review process for the transit project unless conditions for certain exceptions (hardship and protective acquisitions) are met [Ref. 2-42].

2.2.8 Financial Planning

A financial analysis must be undertaken and a financial plan must be developed by the MPO before programming a project into the TIP. The MPO financial plan must demonstrate that TIP projects can be carried out while the existing transportation system is being adequately operated and maintained and that only projects for which funds can be reasonably expected to be available may be included in the TIP.

FTA encourages Project Sponsors to fund NS/Small Starts projects by overmatching Federal funding with the highest possible local share. The general commitment guidelines for New, Small Starts, and Core Capacity Projects include the following:

> **Capital Investment Grant Funding**
>
> *Under the Final Interim Guidance for the Capital Investment Grant program issued in August 2015, "FTA will lock in the Section 5309 CIG funding amount (not share, the actual amount) at the level requested by the Project Sponsor with entry into Engineering." [Ref. 2-3]*

- Any project recommended for an FFGA or SSGA should meet the project justification, local financial commitment, and process criteria established by Sections 5309(d) through (k).
- To the extent that funds can be obligated in the coming fiscal year under existing FFGAs and SSGAs, these commitments should be honored before any new funding recommendations are made.
- The FFGA and SSGA define the terms of the Federal commitment to a specific project, including funding. Upon completion of an FFGA or SSGA, the Federal funding commitment has been fulfilled and additional project funding will not be recommended. Any costs beyond the scope of the Federal commitment are the responsibility of the Project Sponsor, although FTA works closely with Project Sponsors to identify and strategically implement technical and management decision-making means and methods to contain capital costs at the level included in the FFGA or SSGA at the time it was executed.
- Firm funding commitments, embodied in construction grant agreements, will not be made until the sponsors have demonstrated that their projects are ready for such an agreement, i.e., when the project's development and design have progressed to the point where its scope, costs, benefits, and impacts are considered firm and final.
- Funding should be provided to the most qualified investments to allow them to proceed through the process on a reasonable schedule, to the extent that funds can be obligated to such projects in the upcoming fiscal year. Funding decisions will be based on the results of the project evaluation process and resulting project justification, local financial commitment, and overall project ratings, and considerations such as project readiness and the availability of funds.
- These funding decisions will be based on meaningful consideration of the full range of benefits that transit can provide, rather than requiring a medium or higher rating for cost effectiveness, as was previously the case.

As the maximum Federal share decreases, alternative funding sources become increasingly important. Those sources can include taxes, assessments, fees, negotiated investments, private donations, joint development, and other types of public-private cooperation.

49 U.S.C. § 5309 states that: “The Secretary may not approve a grant for a project under this section unless the Secretary determines that … (B) the applicant has or will have the legal, financial, and technical capacity to carry out the project.” The basis upon which the FTA makes determinations of financial capacity is set forth in FTA Circular 7008.1A, Financial Capacity Policy [Ref. 2-43]. The FTA also has provided guidance regarding the content and layout of a financial plan that accomplishes the objectives of the legislative mandate placed upon the FTA and encourages all transportation agencies to prepare financial plans consistent with this guidance. See FTA’s Guidance for Transit Financial Plans [Ref. 2-44].

As an integral component of the planning and development of transit projects, a Financial Plan should include information on the current financial health of the Project Sponsor, such as existing O&M costs and funding, existing and forecast capital spending, and anticipated capital funding sources. The financial plan should also include data on specific new projects that are in planning or development. The details of the project financial information will necessarily change and become more reliable as projects advance through planning and development.

A project financial plan is required to adhere to a specific outline contained in the guidance, including a description of the project, agency-wide and project capital plans, an agency-wide operating plan, project operating revenues and costs, and a 20-year cash flow projection. Appendix A – Cost Estimation Methodology, provides more detailed guidance on cost estimating and project financial planning.

A wide variety of funds can be used for planning activities, including, but not limited to, FTA Section 5303 Metropolitan Planning Grants, FTA Section 5307 Urbanized Area Formula Grants, State Planning and Research Program funds, Surface Transportation Program funds, Congestion Mitigation and Air Quality (CMAQ) Improvement Program funds, and FHWA Planning Program Funds. Capital program funds, including NS project funding, can be used to support planning. Transportation Infrastructure Financing and Innovation Act (TIFIA) loan guarantees are another source of project financing that should be considered.

As a part of transit project financial planning, it may be necessary to coordinate and interface with ancillary projects that are being developed in conjunction with the transit project (street/highway construction or utility modernization) or otherwise complement and reinforce the objectives of the transit project (joint development). Such opportunities for coordination offer potential efficiency benefits for all parties. Opportunities for leveraging local funds can be achieved.

2.2.9 FFGA and Other Grant Requirements

2.2.9.1 *Full Funding Grant Agreement (FFGA)*

FFGAs are authorized by 49 U.S.C. § 5309 and are the designated means of providing NS funding for projects in the amount of $25 million or more. An FFGA:

- Establishes the terms and conditions for Federal financial participation in an NS project.
- Defines that project in detail, both in project scope and in project description, including the schedule and budget.
- Obligates the Project Sponsor to complete construction of the project, as defined, to the point of initiation of revenue operations, and to absorb any additional cost incurred, except under certain specific extraordinary circumstances.
- Sets the maximum amount of NS funds that will be made available for that project.
- Establishes the Federal funding schedule, subject to annual appropriations, in support of the project.
- Ensures a Project Sponsor's efficient management of the project in accordance with all applicable Federal statutes, regulations, and policies.
- Provides the Project Sponsor's commitment to perform a before and after study.

FFGAs can only be executed by the FTA after an NS project has advanced into Engineering. Additional guidance on FFGAs is provided in FTA's Circular 9300.1B [Ref. 2-46].

While the actual negotiation of the FFGA occurs during the Engineering Phase, except in the case of a non-traditional (e.g., D/B, turnkey, D/B/O/M) project, when it must be completed earlier, much of the information required is initially developed during the PD Phase.

2.2.9.2 *Other Requirements*

Circular 9300.1B [Ref. 2-46] provides guidance regarding all capital program grant applications. Requirements include the following:

- The project proposed is a product of the metropolitan / statewide planning process (included in TIP and STIP).
- The grant applicant has or will have the legal, financial, and technical capacity to carry out the project.
- The grant applicant has or will have satisfactory continuing control over the use of ROW and equipment.
- The grant applicant has or will have the capability to maintain the equipment or facilities, and will maintain the equipment or facilities.

Additional sources of FTA requirements include the following:

- FTA Circular 7008.1A, FTA Financial Capacity Policy, governs the determination of financial capacity [Ref. 2-47].

- The determination of management capacity is based on FTA Circular 5010.1D, Grant Management Requirements [Ref. 2-29], which sets forth guidelines and management procedures for Metropolitan Planning grants, Capital Program grants, and Urbanized Area Formula grants. FTA will make this determination based on its experience with an applicant or on an applicant certifying that it has the capacity to comply with this circular.
- Standards regarding the issue of satisfactory continuing control are set forth in FTA Circular 5010.1D, as well as 49 CFR Part 18 "Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments", specifically 49 CFR § 18.31 for real property, 49 CFR § 18.32 for equipment, and 49 CFR § 18.33 for supplies [Ref. 2-48].

2.2.10 Joint Development Planning/Coordination with Transit Project Planning

A wide variety of joint development opportunities may be available in association with major transit projects. These include opportunities that reduce capital and/or O&M costs of a specific project (e.g., shared use of a freight railroad ROW by a commuter railroad), opportunities that generate revenue for a specific project (e.g., allowing development of space within or adjacent to a rail station), and opportunities that increase ridership (e.g., development of intermodal stations or transit oriented development [TOD] or other economic development). Opportunities for joint development should be considered during systems planning, environmental processes, PD, and Engineering. Once joint development projects are initiated, there must be careful coordination with the transit capital project or the existing transit system to minimize disruption of transit customers and/or to achieve maximum mutual benefits.

More than 25 different transit organizations have used joint development arrangements to augment transit capital projects in many different ways. These arrangements provided a source of private sector financing for a transit project that included ongoing revenue to the Project Sponsor in the form of lease payments or fees, utilities or maintenance services for common areas, or just improvement of access to the transit project from surrounding developments.

Joint development projects, however, have not proven to be significant sources of funding for transit. Rather, these projects often are undertaken for mutually beneficial reasons to provide compatible land-use, site design, amenities, or to incorporate customer or community services as might be encouraged through the FTA's Livable Communities Initiatives Program.

Joint development projects require transit agencies to be entrepreneurial and to be effective negotiators. In addition, most joint development projects require transit agencies to reach agreements with local

Transit Oriented Joint Development Opportunities

Rail projects, and any bus project with bus transfer facilities, offer an abundance of joint development opportunities in and around stations. Many Project Sponsors have aggressively pursued joint development opportunities to reduce the cost of the system development or expansions, and these public/private deals may even be structured to assist in bringing in operating revenue to the governments as well as with private developers. Experience in several locations has shown that a good working relationship between the Project Sponsor and the local government leads to better joint development projects.

Joint development projects can have a major impact on project schedules. The average time to develop an agreement is 25 months, and the average time between finalization of a joint development agreement and project completion is 22 months. Intuition says that, the larger the project, the greater the market risk. Entrepreneurial, development-oriented Project Sponsors must still apply sound judgment to properly appraise such risks and minimize them.

To exploit the full potential of joint development in enhancing transit ridership and generating revenues for potential capture by the transit system, attention must be devoted to its design integration with the transit facilities and the adjacent community. The design development process should strive to optimize the site for the benefit of the transit users and to encourage greater transit usage by providing direct and convenient access from all modes to a fixed guideway system and/or from the transit system to local destinations including the joint development. Factors such as location, market, connectivity, access, information, image, user comfort, safety and security, O&M, and management should be addressed.

Numerous issues can typically arise in each step of the process of advancing joint development projects. The following guidance is offered to fully comply with the statutes of the Federal Transit Act:

- Establish the physical and functional relationship of the joint development to transit.
- Coordinate the site and functional plans, particularly in relationship to transit facility O&M, so as to avoid non-incidental uses.
- Design transit and related services in an integrated manner
- Determine the market and financial feasibility of the transit-related components.
- Have supportive land use policies, urban design guidelines, and transportation management plans to increase transit ridership.
- Establish a joint development agreement to address specific issues and institutional arrangements.
- Comply with statutory and regulatory requirements of applicable Federal laws that typically impact federally funded projects, but may not affect private development.

Project Sponsors should refer to the FTA Grant Management Requirements [Ref. 2-30] and the Capital Investment Program Guidance and Application Instructions, FTA Circular 9300.1B [Ref. 2-28]. The circular's Appendix B specifically relates to joint development.

MAP-21 includes a new section 2005(b) establishing a Pilot Program for Transit Oriented Development. The program authorizes funding for a state or local governmental authority to assist in financing comprehensive planning associated with an eligible project that seeks to:

- Enhance economic development, ridership, and other goals established during the project development and engineering processes;
- Facilitate multimodal connectivity and accessibility;

- Increase access to transit hubs for pedestrian and bicycle traffic;
- Enable mixed-use development;
- Identify infrastructure needs associated with the eligible project; and
- Include private sector participation.

2.2.11 Safety and Security Management Plan (SSMP)

2.2.11.1 *Introduction and Background to the SSMP*

FTA Circular 5800.1, Safety and Security Management Guidance for Major Capital Projects [Ref. 2-49] requires the development of an SSMP, referenced as a separate plan of the PMP or on Small Start projects FTA may approve SSMP details for inclusion as a chapter of the PMP.

This requirement formalizes safety and security program management activities, depicted in Figure 2-3. A Project Sponsor may choose to develop either a single SSMP or separate plans for safety and security, respectively. FTA Circular 5800.1 provides detailed instructions on SSMP preparation and explains what projects are exempt from its requirements and the conditions under which total or partial waivers may be allowed.

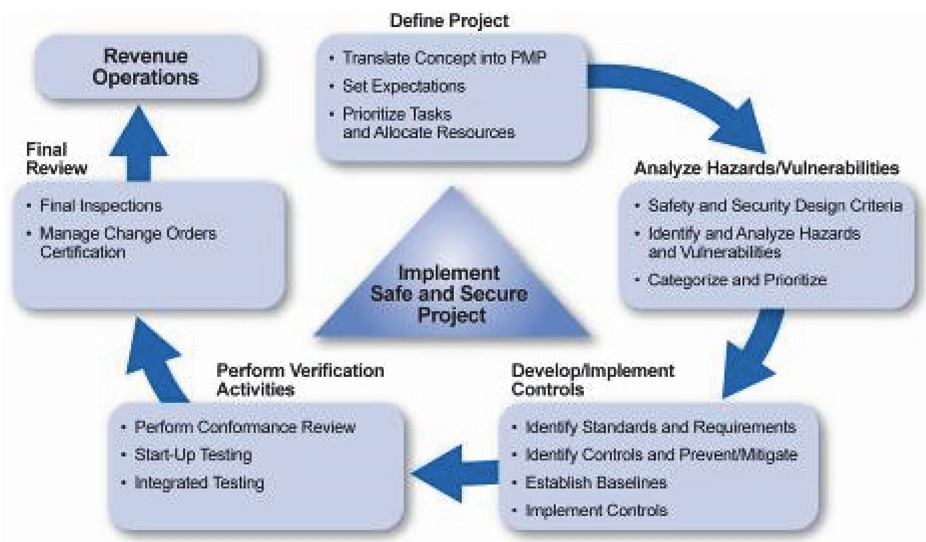


Figure 2-3. Safety and Security Core Management Functions

Thus, for detailed instructions on preparing the initial SSMP and guidance on how to update it as a project moves through its developmental phases, a Project Sponsor should review:

☞ FTA Circular 5800.1, Safety and Security Management Guidance for Major Capital Projects [Ref. 2-49].

Historically, recipients of FTA funding with projects covered under 49 CFR Part 633 described their strategic means and methods for safety and security management and controls as sub-elements of other required PMP sections. This led to considerable variation in how safety and security were handled by different projects. Some Project Sponsors performed specific safety and security activities, including hazard analyses, threat and vulnerability analyses, safety and security certification, or pre-revenue operational readiness assessments, while others did not.

The FTA's aim with issuance of Circular 5800.1 was to strengthen the role of safety and security oversight and management in all phases of project development. FTA was particularly concerned about construction management, where safety and security responsibilities were often devolved solely to the contractor with the Project Sponsor's organization having very little involvement in day-to-day activities.

2.2.11.2 *Authority for and Elements of an SSMP*

FTA statutes, 49 U.S.C. Chapter 53 (as amended October 1, 2012) requires that Project Sponsors with major capital projects include an SSMP as part of their PMP for FTA review and approval. Unless it receives an exemption from the FTA, a Project Sponsor's SSMP must include the following elements and activities:

- A Policy Statement: issued and signed by the Project Sponsor's executive management endorsing the SSMP and stating the project's commitment to safety and security.

- Identification of Safety and Security Interfaces: Identifying who in the project leadership has ultimate decision-making responsibilities for safety and security. Persons must be identified by names, titles, and departments or affiliations and it must be clear how these individuals interface with other project team functions regarding safety and security.

- Establishment of a Safety and Security Organization: The Project Sponsor must establish a specific organization to manage safety and security for the project and must identify by name, title, and department or affiliation, all staff and contractors assigned to this organization. Committees established to support the organization must be identified with similar specificity. A staff member must be designated with responsibility to oversee contractor(s) and an organization chart must be provided that illustrates the entire safety and security management organization.

- Identification of Safety and Security Activities by Project Phase: The SSMP must identify the specific safety and security management activities that the Project Sponsor will perform for each phase of the project, including a budget and schedule for these activities. There are nine required activities within this subsection. They include:
  - Establishing a program based on formal safety and security analysis techniques to identify and assess safety hazards and security vulnerabilities (generally through reliance on a PHA and TVA that is updated during each phase of the project)
  - Establishing safety and security requirements for the project based on applicable codes, guidelines, and standards established by governmental agencies and industry associations. In turn, these requirements should be memorialized within the project's Design Criteria and kept up-to-date.

Procedures must be established to verify that final drawings, technical specifications, and contracts issued for the project conform to its established safety and security requirements.

- Establishing procedures to verify that contractors, staff, and committees build, install, inspect, and test all the project's facilities, systems, and equipment in accordance with the project's stated requirements. Generally, this is assured through an active and ongoing Safety and Security Certification Plan (SSCP), most often overseen by a Safety and Security Certification Committee (SSCC) that is chaired by a senior safety or security staff member employed by the Project Sponsor.
- Document safety, security, and emergency rules and procedures developed for the project, including safety and security plans, operating and maintenance (O&M) procedures and manual, and rulebooks for revenue operations.
- Develop qualifications and training programs for all personnel who will operate and maintain the project in revenue service.
- Document how personnel and/or contractors were trained and qualified to operate and maintain the project and to respond to emergencies. If applicable, the Project Sponsor is required to train and document its training of local emergency response organizations regarding operations, equipment, and emergency procedures.
- Establish and maintain a process to manage open safety and security items resulting from design deviations, change orders, non-conformances, and other sources. Items must be tracked through to resolution (generally fulfilled through checklists established as part of the SSCP that are verified by the SSCC).
- Conduct emergency exercise or drills prior to revenue service; the results must be documented as an after action or similar report.
- Complete final safety and security certification prior to placing the project into revenue service; if applicable, this certification must be documented in a final verification report.

- Ensure Construction Safety and Security: Plans must include safety and security requirements for construction site contractors that must ensure oversight of contractors, must identify safety and security analyses that contractors are required to perform (including, depending on the location and its potential vulnerabilities, site-specific PHAs and TVAs, and, where appropriate, incentives to promote safety and security, including but not limited to bonuses for low injury rates, theft prevention, and safety awards and recognition programs.

- Coordination with External Agencies: As applicable to each project, the Project Sponsor must identify required activities and develop compliance schedules with requirements of all local and state agencies, the PMO, the State Safety Oversight (SSO) agency (SSOA), FRA, and the U.S. Department of Homeland Security (DHS), including its Transportation Security Administration (TSA), Office of Grants and Training (OGT), and others as appropriate. In addition, coordination must be documented with the applicable MPO and with area police, fire, and emergency services organizations.

Where the project delivery method is an alternate to D/B/B, these policies and procedures within the PMP must identify the requirements and the expressed means the Project Sponsor will utilize to ensure implementation by the contractor or concessionaire. This is especially true with D/B/O/M contracting or use of a public-private partnership (PPP). In all cases, the Project Sponsor remains responsible for the satisfactory consideration and implementation of SSMP elements.

2.2.11.3 *SSMP Content*

The following draft outline of an SSMP was derived from Chapter IV of FTA Circular 5800.1, where detailed information is available on the suggested approach to developing an effective SSMP:

- Section 1: Management Commitment and Philosophy
  - Safety and Security Policy Statement
  - Purpose of SSMP
  - Applicability and Scope
  - SSMP Goal
- Section 2: Integration of Safety and Security Into PD Process
  - Safety and Security Activities
  - Procedures and Resources
  - Interface with Management
- Section 3: Assignment of Safety and Security Responsibilities
  - Responsibility and Authority
  - Committee Structure
  - Safety and Security Responsibilities Matrix
- Section 4: Safety and Security Analysis
  - Approach to Safety and Security Analysis
  - Requirements for Safety and Security Analysis
- Section 5: Development of Safety and Security Design criteria
  - Approach to Development of Safety and Security Requirements and Design Criteria
  - Design Reviews
  - Deviations and Changes
- Section 6: Process for Ensuring Qualified Operation and Maintenance Personnel
  - Operation and Maintenance Personnel Requirements
  - Plans, Rules and Procedures
  - Training Program
  - Emergency Preparedness
  - Public Awareness
- Section 7: Safety and Security Verification Process (Including Final Safety and Security Certification)
  - Design criteria Verification Process
  - Construction Specification Conformance Process

  - Testing/Inspection Verification
  - Hazard and Vulnerability Resolution Verification
  - Operational Readiness Verification
  - Safety and Security Certification Requirements
- Section 8: Construction Safety and Security
  - Construction Safety and Security Program Elements
  - Construction phase Hazard and Vulnerability Analysis
  - Safety and Security Incentives
- Section 9: Requirements for 49 CFR Part 659, Rail Fixed Guideway Systems: State Safety Oversight (SSO)
  - FTA issued a Notice of Proposed Rulemaking (NPRM) for the SSO rule on February 27, 2015. FTA's final SSO rule will update the 49 CFR Part 659 requirements when effective.
- Section 10: FRA Coordination
- Section 11: DHS Coordination (to meet the specific mandates of the SSMP, particularly those that pertain to formal safety and security analysis requirements and to integration with other safety- and security-related documents)

Project Sponsors should review not only FTA Circular 5800.1, but also the following documents produced by FTA or related agencies:

- Handbook for Transit Safety and Security Certification (2002) [Ref. 2-50]
- Compliance Guidelines for States with New Starts (2000) [Ref. 2-51]
- Implementation Guidelines for 49 CRF Part 659 (2006) [Ref. 2-52]
- Resource Toolkit for State Oversight Agencies Implementing 49 CFR Part 659 (2006) [Ref. 2-53]
- Hazard Analysis Guidelines for Transit Projects (2000) [Ref. 2-54]
- Guidelines for Managing Suspected Chemical and Biological Agent Incidents in Rail Tunnel Systems (2002) [Ref. 2-55]
- The Public Transportation System Security and Emergency Preparedness Planning Guide (2003) [Ref. 2-56]
- Quality Assurance and Quality Control Guidelines (2002) [Ref. 2-57]
- Designing and Operating Safe and Secure Transit Systems (2005*)* [Ref. 2-59]

FTA has also sponsored the development of a course on Crime Prevention Through Environmental Design (CPTED) that is available through the Transportation Safety Institute website. [Ref. 2-60]

Typically, the Project Sponsor will assign the Safety and Security Review Committee to review and approve activities specified in the SSMP. The Safety and Security Review Committee is generally comprised of senior management personnel, or their designees, who represent the major project areas and activities, including engineering and system integration, architectural design, quality assurance/quality control, industrial and construction safety, security, technical services, construction management, operations and maintenance, contracts administration, labor relations, public relations, cost and scheduling, and training. The Safety and Security Review Committee is generally chaired by the agency's highest-ranking safety official and generally managed, convened, and coordinated by the agency's System Safety Department.

2.2.11.4 *Safety and Security Considerations When An SSMP Is Not Required*

While the process just described is oriented to MCPs that involve a fixed guideway, the principles are also applicable to other transit capital improvement projects. Projects can include new and modernized equipment and facilities that support all modes of transit operations, both fixed guideway and bus/paratransit systems. Elements might include vehicles, maintenance garages, passenger stations and transfer facilities, and control centers.

The process described for Project Sponsors required to prepare an SSMP should be adjusted by Project Sponsors for other projects based on the scale and requirements of the project being implemented. Typically, safety and security certification and hazard analysis will be required of the project at a minimum. The principles that assure that safety and security are considered at each phase of a project are just as important for a small project as for an MCP. In fact, because the small project's safety and security staffs may be far smaller than those of an MCP, it is particularly important that these functions not be delegated to those with little expertise or interest in seeing that they are adequately addressed throughout all project phases.

Grade Crossing Safety Improvement Programs

Rail transit lines with at-grade operations with/adjacent to crossings will have grade crossing issues that need special attention in design and their operation. These systems are troubled by the problem of impatient motorists driving through red traffic signals or around lowered crossing gates designed to warn them from approaching trains. A grade crossing safety program should commence in the design phases, and the criteria made part of the project's formal, baseline Design Criteria and Project Definition. The four principal elements of such a program are: engineering/design, enforcement, education, and legislation. For any grantee embarking on projects with grade crossings, it is prudent to reach out to peer properties (and APTA) that have been through the issues for adoption/adaptation of their approaches, as well as the State and local safety departments and regulatory agencies

2.2.11.5 *State Safety Oversight Agency Considerations*

With the implementation of MAP-21, 49 U.S.C § 5329 has been revised to increase the FTA's and SSOA's safety oversight and authority of transit projects, specifically during engineering and other phases prior to start-up. Accordingly, FTA and SSO agencies have instituted increased oversight activities of capital projects, specifically with on-site reviews. As of early 2016, FTA is undergoing the NPRM process to support developing the national safety plan and clarifying safety oversight and requirements.

In partnership with the FTA regional office, FTA's Headquarters Office of Transit and Safety Oversight (TSO) may conduct Safety and Security Readiness Reviews (SSRR) prior to revenue service. The SSRR includes document reviews, on-site interviews and project tours to ensure readiness implement 49 CFR Part 659 and other requirements. SSRRs are typically scheduled three to twelve months prior to the rail transit agency's proposed revenue service date.

The SSOA may conduct a pre-review safety assessment of the project prior to revenue service and during various phases of the project. The Project Sponsor can refer to the SSOA's program standard for full delineation of the state minimum oversight requirements, and to detail in the current 49 CFR Part 659 regulations.

2.3 Engineering and Design

Projects are developed and implemented by being advanced along a continuum that includes detailed planning and design activities through and including testing, start-up, and ultimate operation of the transit system project. FTA defines design and engineering phases as PD (or Project Development) and Engineering. These fit with the typical FTA process and time-phased development for MCPs as follows:

- PD Phase, including completion of NEPA requirements
- Engineering Phase (NS and Core Capacity)
- Full Funding Grant Agreement (FFGA)
- Small Starts Grant Agreement (SSGA)

2.3.1 Definition of Sufficient Level of Engineering

At each project phase, a sufficient level of engineering will need to be performed before the Project Sponsor moves to the next phase. The term "sufficient level of engineering" is defined as follows for each phase of development.

1. **Prior to Completion of National Environmental Policy Act (NEPA) Process**
   Adequate level of engineering and design to identify and define all mitigation measures and allow preparation of a complete mitigation monitoring plan and a cost estimate with an adequate level of contingency to allow for changes due to design development.
2. **Concurrent with the Completion of NEPA but before Entry into Engineering (New Starts and Core Capacity)**
   At least 30 percent design and engineering, including documents at the level of detail described in the Final Interim Policy Guidance - FTA Capital Investment Grant Program of August 2015. This includes an adequate level of engineering to define project key design features, including satisfactory progress in advancing the project design and a corresponding and up-to-date cost estimate and schedule. At a minimum, the level of design detail should be as described in FTA's Checklist for Approval to Enter Engineering. The supporting capital cost estimate must be based on quantities of work established in the drawings and a substantial level of cost line item detail and backup for all other costs (vehicles, equipment, real estate, professional services, unallocated allocated contingency, and financing costs). At a minimum, the level of design detail should conform to the checklist in Appendix C to these ***Guidelines***.

3. **Concurrent with Engineering But Before Full Funding Grant Agreement (FFGA) (New Starts and Core Capacity)**
   Consistent with Final Interim Policy Guidance - FTA CIG of August 2015, an adequate level engineering to define project key design features appropriate for the designated delivery method (D/B, D/B/B, and/or CM/GC, including satisfactory progress in advancing the project design and corresponding and up-to-date baseline cost estimate, risk analysis, schedule, and project management plans and sub-plans. The level of design detail should conform to the checklist in Appendix D.
4. **After Completion of NEPA Before a Small Starts Grant Agreement (SSGA)**
   Consistent with FTA's Final Interim Policy Guidance - CIG of August 2015, an adequate level engineering to define project key design features appropriate for the designated delivery method (D/B, D/B/B, and/or CM/GC), including satisfactory progress in advancing the project design and corresponding and up-to-date cost estimate and schedule. At a minimum, the level of design detail should conform to the checklist in Appendix D.

2.3.2 Project Development (PD)

All interagency and other third-party agreements that will be required to implement the project should be identified during PD and these agreements should be executed to the extent possible. At a minimum, the Project Sponsor should seek preliminary agreements from key project stakeholders prior to Engineering and establish confidence that the proposed project is acceptable to these third parties, and that required project approvals can be obtained by design completion.

A Value Engineering (VE) study should be conducted prior to the completion of PD. This study should confirm that the PD Phase effort has fully evaluated all feasible and reasonable configurations and design options. The Project Sponsor should document the design and configuration alternatives developed during the VE study as well as its own process for evaluating and accepting or rejecting the VE proposals. Any accepted VE proposals should be incorporated into the PD design documents or noted as design refinements to be undertaken as early as possible in the Engineering Phase.

A constructability review should be conducted by agency or agency and consultant staff with experience in construction of similar projects. The constructability review should consider the likely response by contractors bidding on the proposed project as well as the ability to efficiently construct the project including critical interfaces among construction activities, availability of sufficient staging and work areas, ability to maintain traffic and pedestrian operations, and conformance to common construction means and methods for the project area. The Project Sponsor also may wish to conduct a peer review involving other transit agencies that have implemented similar projects. Peer reviews are an effective way to incorporate lessons learned from other projects and to identify best practices to carry forward into the Engineering Phase of the project.

The project delivery and contract packaging plans should be finalized during PD. This includes the type or types of contracts to be used to complete design and construction, the approach(es) for packaging the construction work (if more than one construction contract is envisioned) and the roles and responsibilities of the agency staff, consultants, and other participants in the project. The selection of the project delivery method should consider a range of factors, including project cost, project schedule, the degree of design control desired by the Project Sponsor, the status of ROW acquisition and utility relocation, project risks and the ability to manage and appropriately allocate risks, legal and regulatory requirements and the Project Sponsor's experience with the various delivery methods. The contract packaging plan identifies all of the consultant, third-party, and procurement and construction packages that will comprise the project from Engineering through Project Activation to operations. The contract packaging should seek to maximize design and construction efficiency, minimize conflicts and provide workable interfaces among contracts and contract participants (e.g., design service during construction and the procurement of materials and equipment), and encourage competition among consultants and/or contractors. Larger construction and/or materials/equipment contracts that combine multiple components of the project will reduce the number of contract interfaces to be managed, but a more limited number of contractors may be able to bid on these types of contracts. More complex contracting methods will generally require more active management by the Project Sponsor to assure that the interfaces among the contracts are effectively managed.

The contracting strategy and packaging plans for modernization or SGR projects need to address factors beyond those considered for new construction. Some rail modernization subsystem projects can be packaged by corridor, rail line, or line segment to facilitate coordination in design and construction. The subsystems for which this is most beneficial are civil structures, track structures, architecture, utilities, signaling, operations control and communications system, and power systems. This permits work on multiple subsystems to be accomplished during a single service outage, minimizing operational conflicts. Coordination is also required between the vehicle and maintenance/storage facility elements, especially when new vehicles are acquired. Stations tend to be somewhat isolated from other subsystems in their modernization, except for assuring physical interfaces such as between the railcar and the platform, and between station security systems and the control center. Project sponsors considering an extensive modernization or SGR project should consider the overall staffing requirements needed to perform the project while attending to the normal demands of operation and maintenance.

For MCPs, a Risk Assessment must be conducted early in the Engineering Phase. The risk assessment is intended to determine if the requirements risks for the project have been fully mitigated through the PD process and to identify the remaining design, market, and construction risks. The adequacy of schedule and cost contingencies and specific plans to mitigate the remaining project risks should be evaluated in the risk assessment. The analysis should determine if the project delivery method and the cost estimate reflect an effective allocation of risks to the parties with the best capability to control each risk.

The PD portion of the total project feasibility analysis and design effort, when properly conducted, will permit the project to move more rapidly into and through Engineering with a minimum of design changes, disruptions, or delays. A major aspect, and significant in assuring the success of the project development process, is the development and continued refinement of the PMP and sub-plans developed under the auspices of the policies and procedures identified in the PMP, such as, but not limited to, the Fleet Management Plan (FMP), the Real Estate Acquisition Management Plan (RAMP), the Safety and Security Management Plan (SSMP), etc.

Projects to modernize an existing transit system may consider the utilization of Project Sponsor staff for roles including design, design reviews, construction, and testing, in addition to start-up. If sufficient safety and security staff exist, they should also be involved in all phases. For systems that lack sufficient staff capabilities in safety and security, contractor personnel must nonetheless be overseen by a competent member of the Project Sponsor's staff, possibly with technical assistance from an outside safety/security vendor or from local law enforcement agencies if they have sufficient training and expertise in CPTED and SCP techniques.

Design reviews should consider compatibility with the existing system, from both an operating and a maintenance perspective, and constructability, especially while maintaining safe operations. Force account (i.e., agency or third-party stakeholder) labor may also be utilized for certain track, signal, and electrical work, in addition to providing for the safe working environment of contractors.

The utilization of force account resources to support project design and implementation should be planned during PD, but must be justified in accordance with FTA Circular 5010.1D [Ref. 2-29].

The FEIS (or other NEPA-required document leading to a FONSI or CE), is completed during PD as well as the definition of the more detailed design features for the project. FTA, state, and local requirements must be identified to guide the design process. These encompass, but are not limited to, safety, security, environmental, and design standards, including compliance with the Americans with Disabilities Act (ADA) and with the Standard for Fixed Guideway Transit and Passenger Rail Systems (National Fire Protection Association document NFPA 130).

Following is a list of key deliverables required to define the project at the completion of PD:

- Sufficient design and engineering plans and outlined specifications
- Design analyses, project definition, design criteria, value engineering and operational criteria reports
- Capital cost estimate
- Operating plan
- Financial plan
- Project delivery method and contract packaging plan

- Risk assessment
- Identification of required third-party and utility agreements and permits
- Identification of required right-of-way or property rights
- Project schedule, including detail for the Engineering Phase, and preliminary schedule for Project Activation (testing and start-up)
- Final NEPA documentation (i.e., CE; FONSI, ROD based on an FEIS)
- Programming of Engineering Phase and the construction and procurement of materials/equipment in the TIP and STIP
- All documentation required under the New Starts program (for New Starts MCPs)
- PMP that demonstrates the legal, financial and continued technical capability and capacity to undertake the proposed project
- PMP sub-plans required by FTA as integral to the PMP document itself or as separate documents with the initial findings and determinations in the area of fleet management, real estate needs/acquisition program, safety/security needs and program, etc.

Some of the specific requirements for the deliverables for the PD phase will depend on the selected project delivery method. The selected project delivery method will also influence the development of the Project Sponsor's Project Management Plan. Table 2-3 provides an overview of differences in the requirements for selected deliverables from the PD Phase for three basic types of project delivery, including D/B/B, D/B, and PPPs. Be aware that other project delivery methods, such as CM/GC, may be employed.

Regardless of the project delivery method, the integrated master project schedule (IMPS) and cost estimate must meet minimum requirements.

Table 2-3. Deliverables by Project Delivery Method

Project Component	Design/Bid/Build (D/B/B)	Design/Build (D/B)	Public-Private Partnership (e.g., D/B/O/M)
Design Drawings	Plan and profile drawings, typical sections, elevations, type-size-location for major structures, facility design development	Plan and profile drawings, typical sections, elevations, type-size-location for major structures, facility design development	Plan and profile drawings, typical sections, elevations, type-size-location for major structures, facility design development
Specifications and Design Standards	Outline design specifications; adopted design standards	Performance specifications for design; adopted design standards	Performance specifications for design operations; adopted design standards
Contract Packaging Plan	Identification of planned construction contracts and related design packages and identification of procurement contracts	Identification of planned design/construction contracts (if multiple contracts proposed) and procurement contracts	Single contract assumed. Definition of operating, maintenance and financing requirements and contract duration. Definition of funding sources and treatment of operating revenues
Cost Estimates	Contract package and project level cost estimates. Documentation of project budget by package to support cost control.	Contract package and project level cost estimates.	Program level cost estimates, including long-term operating and maintenance cost forecasts.
Contract Documents	Scope of work and contract for design	D/B procurement plan, including RFP documents, D/B contract terms and conditions and D/B proposal process	Public private partnership procurement plan, including contract terms and conditions, identification of funding
Right-of-Way	Preliminary right-of-way plans, preliminary identification of required property acquisitions	All right-of-way requirements identified and, ideally, all required right of way acquired	All right-of-way requirements identified and, ideally, all required right of way acquired
Utilities	Preliminary utility plans and identification of required utility agreements	All utility requirements identified, utility agreements in place and, ideally utility relocations completed	All utility requirements identified, utility agreements in place and, ideally utility relocations completed
Third-Party Agreements and Permits	Third-party agreements and required permits identified. Preliminary third-party agreements executed.	Third-party agreements and permits executed.	Third-party agreements and permits executed

The Federal share of the capital cost is established at the entry of the project into Engineering. The requirements for the project capital cost estimate include:

- Identification of all elements of the project consistent with the project definition and work breakdown structure (WBS), and correlation of the WBS with and cross-referenced to the FTA Standard Cost Categories (SCC) budget preparation and presentation
- The estimate methodology, describing the method of assembling the estimate and including all assumptions and references used to construct the estimate, methodology for establishing material, labor and equipment costs and production rates, and basis of identified lump sums or allowances for known but incompletely designed items
- Completed quantity take-offs for defined major components of project including earthwork, guideway structure, track or surfacing, walls, major structures, major utilities, stations, vehicles, individual system elements
- Consistency of estimate basis with procurement/project delivery method
- Documentation of sources of parametric and/or unit costs, reflecting local conditions, current market conditions and project delivery method
- Identification of all soft costs (i.e., non-construction agency, third party, force account, and consultant) components, with sources and methodology consistent with project delivery method
- Force Account costs for construction and specification of labor costs and methodology
- Reflection of project delivery method and schedule in the estimate
- Basis of escalation rates, consistent with schedule and based on current local (and specialty) market analysis
- Contingency amounts appropriate for level of project definition; developed by major cost categories; reflective of complexity, uncertainty and risk of each category and overall project; reflective of project delivery method and risk allocation; contingency clearly separated into allocated and unallocated amounts

The minimum elements for the project's IMPS include:

- Activities consistent with project definition, work breakdown structure (WBS), project management plan, known external constraints, deliverables, and logic relationships among tasks, and implemented in CPM schedule software (e.g., MS Project, Primavera, or other comparable software)
- Schedule Narrative, describing the WBS, critical path, expected durations, and logic
- Basis of Schedule, including all assumptions, basis of durations and explanation of approach used to develop schedule
- Schedule Activities shown at appropriate levels of detail
- Professional Services Procurement showing procurement for management and design consultants as needed, consistent with project delivery method

- PMP and sub-plans showing planned completion or updates for PMP, RAMP, BFMPs, SSMP, QMP, and other proposed sub-plans
- Environmental Permitting - Show major activities and deliverables for required permitting activities including logic ties to design and construction activities, anticipated contractor initiated permitting activities, and process for confirming design of committed environmental mitigation measures
- Dates for interagency agreements, Permits, third-party agreements, utility and railroad agreements, and other approvals or actions; show logic ties to design and construction activities
- Engineering showing detailed design activities by major milestones and associated review periods
  The first design deliverable should be the advancement of the PD Phase analyses and reports (especially the design and operational criteria) to refined facilities, equipment, materials, and vehicle identification. Include activities for plans, specifications, special studies, or reports and appropriate logic ties.
- Real Estate, including schedule outline for real estate acquisition and relocation activities with logic ties to design, procurement, and construction.
- Identify and include appropriate notices to property owners (and tenants), procurement of appraisal services, appraisal and review appraisals activities, Project Sponsor review and decision-making, and relocations, etc. Develop individual schedules for complex or unique property rights transactions. Verify legal timelines with the Project Sponsor's real estate manager
- Engineering/FFGA, including target date for execution of agreements, including Project Labor Agreements, Freight Railroad agreements, necessary submittals, and FTA and other governmental reviews
- Construction Phase Professional Services, including procurement for Construction Management and any other construction support services, e.g., Owner Controlled Insurance Program (OCIP), real estate services, surveying, materials testing, etc., as applicable
- Construction and Equipment/Materials Procurement showing outline level for procurement activities for major construction and equipment/material packages; procurement schedule and activities reflect project delivery method
- Construction and Equipment/Materials showing outline-level schedule for each major construction and equipment/materials procurement package (5 to 15 activities per package); critical dependencies among packages, long lead time items, and relationship to owner furnished equipment or materials; and regulatory or other constraints;
- Construction schedule must be consistent with project delivery method
- Testing and Start-Up (also referred as project activation, e.g., rail activation), showing preliminary testing, acceptance and start-up activities (including mandatory training) with logic ties to construction and proposed revenue service date(s)

- The Integrated Master Project Schedule, or IMPS, consistent with the Project Definition, Capital Cost Estimate, and PMP. (Note: At the PD Phase and for all subsequent phases, the Project Sponsor most likely develops the IMPS from separate, detailed schedules for definitive categories of project work, e.g., design program and participants, FTA and other governmental approvals, permitting, Real Estate program, individual construction packages, individual equipment and materials procurement packages, etc., setting key milestones of each rolled up into the IMPS to portray the overall project. Thus, the Project Sponsor must carefully create the separate, individual activity schedules first, then correlate them to one another, and, finally, use the key milestones, durations, and respective critical paths to populate the IMPS and identify the overall project critical path.)

A major aspect of the PD effort, which is significant in assuring the success of the project development process, is the continued refinement of the Project Management Plan and the development and refinement of the required sub-plans, including:

- Real Estate Acquisition and Management Plan (RAMP)
- Rail and/or Bus Fleet Management Plan (RFMP and/or BFMP)
- Safety and Security Management Plan (SSMP)
- Quality Management Plan (QMP)
- Document Control Plan
- Configuration Management Plan
- Risk Management Plan
- Contingency Management Plan
- Force Account Plan

The PMP must demonstrate that the Project Sponsor has the authority and the resources required to direct and control the project, with a focus on the subsequent risk-informed, performance-based management of the Engineering process (for D/B/B project delivery). Project Sponsors proposing alternative project delivery methods must demonstrate the ability to manage and control the approvals of the design and follow-on construction work, since they will be contracting for the partial or complete delivery of the project before having a 100 percent completed design.

2.3.3 Engineering Phase

The purpose of the Engineering Phase is to prepare complete and final drawings, technical specifications, and contract requirements documents necessary to advertise and obtain competitive construction (and/or equipment/materials) contract bids. This includes clear statements of testing requirements and acceptance criteria for the safety and functionality of all subsystems. Typically, this phase also includes the preparation of the engineer's estimate and detailed schedule, analysis of the construction bids, and award or recommendation for award, and Real Estate acquisition.

While the definitions for the Engineering and Construction Phases presented here or later in this report are typical for transit projects, there may be situations where design and construction tasks for parts or the entire project could be integrated and the overall implementation time frame could be compressed. Examples include "fast track," D-B, Concession or Public-Private Partnership, or in conjunction with a joint development project.

For traditional Design/Bid/Build project delivery, Engineering is the last phase of project development prior to construction. FTA policy dictates that Engineering cannot begin prior to NEPA completion as denoted by an FTA Record of Decision (ROD), FONSI, or CE determination.

Appendix D, referenced in the Sufficient Level of Engineering discussion earlier in this chapter, presents the checklist utilized by FTA to keep track of requisite Project Sponsor submittals required to enter the Engineering Phase, presents a checklist utilized by FTA to keep track of requisite Project Sponsor submittals required to enter the Engineering Phase.

FTA may issue a Letter of Intent to an applicant indicating a willingness to obligate funds for a project from future budget authority. Another instrument available to FTA is the LONP, discussed earlier in this chapter. Automatic Pre-Award Authority allows for reimbursement of preliminary costs of project implementation, including land acquisition, utility relocation, and long-lead procurements for which specifications are determined, and other activities that will promote completion of the project more rapidly and at less cost. The FFGA commits a Federal share of the cost of construction and a funding schedule, subject to appropriations by Congress. FFGAs are discussed in Section 2.2.9.1.

The Engineering process is applicable to SGR, bus facility, and other transit projects. The inputs are the direct result of PD and the outputs become the foundation for the subsequent phases – construction, testing, and start-up (also referred as activation), and revenue service. Engineering can extend well into the construction phase in that portions can be designed while other portions are being built and/or operated.

To avoid delays and substantial added costs that are likely to accompany changes in the detailed design, the project scope should be decided by the completion of the PD and “frozen” at the initiation of Engineering. Changes in the project definition or scope (with potential and consequential impacts on the project budget and schedule) should be permitted only for compelling reasons, i.e., substantial economies achieved through VE, accommodation of changed conditions as a result of construction planning, reduction in funds or changes in funding agency criteria, and other reasons for which the consequences of not changing are substantially more adverse than the risk of delay and the increase in design and/or construction (or equipment/materials procurement) cost.

During the Engineering Phase of a fixed guideway project, FTA and the Project Sponsor will negotiate a construction grant contract (e.g., an FFGA for an NS project) with a fixed amount of the Federal contribution. For NS and Core Capacity projects, this amount will be fixed at entry to Engineering. All NS projects, prior to their consideration for an FFGA, are required to undergo project scope, cost and schedule reviews and Risk Assessment updates as deemed necessary, along with updated reviews of, technical capacity and capability, the PMP, and relevant PMP sub-plans.

An FTA grant contract is required for non-NS projects, but is not typically a "full funding" grant.

2.3.4 Construction and Equipment/Materials Procurement Phase

The Construction and Equipment/Materials Procurement Phase includes the physical building of all structures of the transportation improvement, the fabrication or manufacturing of the components and subsystems. This equipment and material will be installed with the fixed facilities to form the system. All procurement shall comply with Buy America requirements as detailed in Section 2.1.2.3.4. Construction bid packages are prepared during Engineering and are bid upon by contractors for various aspects of work. Particularly for projects in which construction will be divided among a number of bidders, the Project Sponsor should consider developing a Construction Safety and Security Manual (to be issued along with pre-bid documents) that explains to bidders the safety and security requirements they will be expected to adhere to at each construction site. Construction management is performed by the Project Sponsor or its consultant and involves oversight of the work in progress, both contractor and force account; cost and schedule control; subsystem inspection and testing; quality assurance; and documentation of as-built configurations, QC inspection records, and deficiency lists.

Prior to the award of each construction contract, all real estate necessary to the contract work should be acquired, including land that may be leased for construction plant and access. During the Construction phase, revisions of the design or even redesign may be necessary to accommodate unanticipated site conditions, including those pertaining to safety and security of employees or the site and surrounding areas, or resulting from accepted contractor developed value engineering change proposals (VECPs), final manufacturer's drawings, errors, and other factors.

The inputs are the direct results of the Engineering Phase and the outputs are the fixed facilities, equipment, plans, and procedures required for the Testing Phase. To facilitate implementation of the Construction phase, the Project Sponsor should develop a Construction Management Plan to assure implementation of the proposed transit improvements in accordance with the designs, specifications, and resources established in the previous phases. Special attention must be devoted to construction activities adjacent to an operating system to assure the safety of transit riders, operating employees, and construction workers during modifications to existing transit facilities. The construction management plan must consider security requirements of a construction site, particularly one adjacent to an existing facility or in a high-traffic or high-crime area. Similarly, for Equipment/Materials Procurement, the Project Sponsor should develop a specific plan for each contract to procure system equipment element(s), e.g., signals, traction power and substations, communications, Fare Collection, etc., to assure that the specifications and contract data requirements are being followed, inclusive of subsystems inspection and testing before assembly or shipment to the job site.

2.3.5 Recovery Plan

This is the action that neither Project Sponsors nor FTA want to have to invoke. For MCPs in particular, the FFGA and the Project Management Plan (PMP) will each include the requirement that the Project Sponsor address negative trends relative to project costs and approved project schedule as soon as they appear. Realistically, these negative trends are likely to appear during the Engineering Phase and must be dealt with then, and certainly not ignored on the presumptive basis that they might be mitigated through bidding (“market risk” resolution) or contractor improvements in means/methods or schedule efficiencies (“construction risk” resolution). Based upon a large sample of transit and other major public works projects, negative budget and schedule (with schedule matters also invoking cost) impacts are seen to include, but are not limited to, the following:

- Overruns occurring all too often with the soft costs during design
- The Engineering activities proceeding without adherence to the principle of “design to budget”
- Inadequate change control with concurrent reflection of negative cost and schedule impacts on the Basis for Design, and controls
- Incomplete construction document Quality Control with respect to intradisciplinary and interdisciplinary review of plans and specifications
- Incomplete plans and specifications
- ROW not being completely and accurately defined and acquired so as to provide straightforward progress by the contractor

The Risk Assessment and consequent development of Contingency funds within project budgets and “hold points” for MCPs will assist in determining if and when a Recovery Plan may be required. The intent of such a plan is to invoke strategic means and methods of mitigating cost and schedule overruns that are identified through trending and cost to complete analyses. For MCPs, there is a requirement to identify Primary and Secondary Mitigation elements of the project and/or project delivery that may be available to mitigate potential negative impact on either the budget or schedule, or both. Chapter 3 provides more detail on budget development, risk assessment and management, contingencies and overall management process for project phases beginning with PD and running through the Construction and Equipment/Materials Phase.

Mitigation cannot compromise the integrity of the project as it was defined in the FEIS or otherwise approved by FTA via a FONSI or CE. The recovery options that may be available should not alter the project’s planned level or quality of service to the public. Project Sponsors are cautioned to monitor and evaluate budgets and schedules rigorously, provide robust trend analyses and cost-to-complete forecasting, and report to FTA any conditions that may adversely affect the project so that a Recovery Plan may be prepared transparently and with FTA input.

Testing and Start-Up Phase

The Testing and Start-Up Phase is also often referred as the Activation Phase (e.g., rail activation) and culminates with the acceptance of an operating transportation system (or improvement) in accordance with predetermined criteria, based on the satisfactory completion of the construction of fixed facilities, the installation and test of all equipment and subsystems, and the integration of all components into a fully functional transit system. Tests include manufacturing plant and on-site performance testing of major systems and subsystems and integration testing of the rolling stock, systems, and subsystems in their designed and constructed operating environment. For major projects involving New and Small Starts, Core Capacity or significant changes to existing fixed guideway systems, an Integrated Test Plan (ITP) may be required. Acceptance of the system and subsystems by the Project Sponsor implies that all design requirements and specifications related to both safety and functionality have been met. Accordingly, the completion and acceptance testing is key to the Safety Certification process.

Start-up involves the full operation of the accepted fixed guideway system or improvement in a functional test and training mode by the Project Sponsor's personnel prior to its use in revenue service. *Pre-revenue* typically refers to simulated revenue service operations without passengers. Further Testing and Start-Up responsibilities of Project Sponsors are provided in Chapter 6 of this document.

2.3.6 Revenue Service Phase

2.3.6.1 *Operation and Maintenance*

The Revenue Service Phase is the period of normal system operations that occurs after the transit capital project has been completed. Revenue Service begins when the system accepts transit passengers for revenue service and when stations, etc., are open to patrons for normal use of the facilities. It should be based on the Operating Plan developed previously.

From the perspective of effective transit project management, Project Sponsor attention during the Revenue Service Phase should focus on the safe operations and maintenance of the facility(ies). The Project Sponsor should check safety and security installations (such as CCTV cameras, public address systems, placement of Fare Collection equipment, and placement of ADA-required facilities or signage) to assure that they meet the requirements of Revenue Service. Further, attention should be directed to identifying any unanticipated patron volume and patterns of use of any portion of a new facility, as these may result in the need to alter placement of safety and security equipment, signage, or other features. An ongoing process of planning and analysis of performance statistics should be structured to define the need for future projects to modernize or supplement the operating transit system. The Project Sponsor may then institute a continuous quality improvement program to identify opportunities for improving the cost-effectiveness of transit service and making modifications to improve performance. The program should include a formal configuration management process governing design, implementation, and ongoing operations that approves and documents system changes.

2.3.6.2 *System Performance Monitoring/Assessment*

Project Sponsor efforts during the Revenue Service Phase should be directed toward maintaining and improving a high level of system performance and planning for modifications and improvements to the existing transit system. Project Sponsors may undertake planning initiatives related to new routes, new service and extensions, which would be encompassed within the Planning phases as discussed in Section 2.2.

The experience of the Bay Area Rapid Transit (BART) system in San Francisco is applicable to fixed guideway transit systems. Supported by an effective operational performance information system, BART has focused its planning and analysis efforts on overcoming system design deficiencies, improving operational performance, and increasing passenger carrying capacity. This process involves periodically revising the organization's goals and operating performance objectives, developing capital and operating programs, and monitoring ongoing system performance both in general terms and against specific performance objectives.

BART instituted its Reliability Improvement Program (RIP) after that agency's rail line was originally constructed to methodically improve system reliability and safety. The RIP included a definition of key system problems, analysis of their effect on service and measurable performance units, establishment of performance goals, careful assessment of the primary causes of the unsatisfactory performance, design, and implementation of the most potentially effective projects to solve the problems, and measurement of the impact of the changes. BART also incorporated a Reliability Centered Maintenance program to augment these processes.

Project Sponsors may also benefit from reviewing and incorporating techniques described in the FTA's Transit Performance Monitoring System (TPMS) Results [Ref. 2-62].

2.3.6.3 *Before and After Study*

FTA's December 2000 Final Rule on Major Capital Investment Projects (49 CFR Part 611) included several provisions that incorporated Before and After Studies into the NS process. Project Sponsors collect and preserve information on the following five project components generated during project planning and development:

- Project scope
- Transit service levels
- Capital costs
- Operating and maintenance costs
- Ridership patterns and revenues

FTA's Circular 5200.1A – Full Funding Grant Agreements Guidance [Ref. 2-45], moreover, notes that a Before and After Study Plan is required by Project Sponsors pursuing an FFGA. (Section 11 of Chapter 2 in the circular discusses this requirement.) This Plan should be prepared during PD, but no later than award of FFGA or SSGA. The purpose of the Before and After Study Plan is to make sure that data collection and analysis are done in ways that ensure that all comparisons made are complete and accurate. There are many factors (internal and external) throughout a project's life that will result in changes; therefore, this Plan must include the Project Sponsor's procedures to capture and document changes, preferably as they occur. However, it is important to note that collection and preservation of project information/data by the Project Sponsor typically begins during the project alternatives analysis and before entering PD. Project Sponsors are required to preserve this data at each of the following project milestones:

- Before Award of FFGA or SSGA
- Prior to start of revenue operations
- Two years after the start of revenue operations

For further information regarding the preservation of project data, as well as guidance on the preparation of a Before and After Study Plan and the actual Study itself, Project Sponsors should reference FTA's August 2015 Interim Policy Guidance. [Ref. 2-3]

2.3.6.4 *Capital Replacement Planning*

FTA has sponsored studies that address SGR and asset management planning and analysis issues. Because of the FTA funding categorization, SGR has become synonymous with the term "capital replacement" and encompasses the following:

- *Refurbishment* - The renovation, restoration, redecoration, revamping or overhaul of equipment and facilities to adequate standards of performance and a "State-of-Good-Repair", which, if neglected, could cause safety hazards or serious disruption of service. Refurbishment should occur at the interval(s) recommended by the construction contractor/designer, or the manufacturer or supplier of the system and/or equipment. It can be generally accomplished by transit agency's maintenance staff. Refurbishment should result in the capability to sustain the existing system performance for at least five years with only a nominal increase in life cycle costs.

- *Rehabilitation* - The substitution of new materials, components or subsystems having basically the same fit and function for the worn or weakened original equipment. Rehabilitation should occur at the design mid-life of the system or equipment. Due to the extensive scope of the rehabilitation work that will require dedicated labor to complete it in a timely manner and to reduce the downtime of the affected system or equipment, transit agencies typically hire an outside independent contractor to perform it. Rehabilitation should result in an improvement in system performance for a range of 5 to 20 years and a reduction in life cycle costs.

- *Modernization* - The use of proven new materials, components, or subsystems to meet higher standards of productivity than are possible with the original equipment or materials. Modernization would occur as needed, primarily as a result of the obsolescence, limited shelf life, or non-availability of a material, component, or subsystem. Modernization would typically require a two-phase implementation – first, requiring design, acquisition, and successful testing of a new prototype; and secondly, with a system-wide full-scale replacement. Modernization should result in reasonable improvements in system performance for a period ranging from 10 to 30 years at no increase in life cycle costs.

Each potential Project Sponsor should develop a methodology for planning and programming capital replacement projects based on a variety of performance and cost criteria and a process to assist in project identification and prioritization. This process and methodology should document and track the condition and (initial and replacement) costs of existing facilities, equipment, and rolling stock; it should also include schedules for major maintenance or replacement, as well as estimated refurbishment and/or replacement costs.

The capital cost of an SGR project may be justified by the corresponding reduction in O&M costs. The ratio of the annual O&M cost savings to the capital cost of the improvement is called the return on investment (ROI). The time it takes for the annual O&M cost savings to equal the initial capital investment is called the payback period. The greater the ROI or the shorter the payback period, the more attractive is the associated capital investment. An example is the replacement of a manual train control system with a partially or fully automated system. The new system could be economically attractive if the net reduction in O&M cost was high in relation to the capital cost of the automation equipment.

2.3.6.5 *State Safety Oversight (SSO)*

In 1991, the National Transportation Safety Board (NTSB) released a series of recommendations to the Federal Transit Administration (FTA) regarding the need for safety oversight of rail transit agencies by state government. In response to these recommendations, Congress added Section 28 to the Federal Transit Act (codified at 49 U.S.C. § 5330). Based on this new authority, FTA developed a rule that went into effect in 1998 creating the first-ever state-managed safety and security oversight program for rail transit agencies not regulated by the FRA. Published as Rail Fixed Guideway Systems; State Safety Oversight, this regulation subsequently referred to as the SSO Rule or Part 659. FTA revised Part 659 in a Final Rule published in 2005 [Ref. 2-63]. As noted, FTA is undergoing the NPRM (as of early 2016) process to support developing the national safety plan and clarifying safety oversight and requirements.

FTA's SSO rule stipulates that, among other activities, agencies designated by states to oversee rail transit safety and security must make annual reports to FTA. To facilitate this reporting, each January, FTA distributes an Annual Reporting Template to all SSO agencies. This template captures data pertaining to all reportable accidents, determined probable causes, corrective action plans, changes to program documentation, and agency resource allocation. SSO agencies submit their completed annual reports to FTA by March 15 of each year for the preceding calendar year.

Rail fixed guideway systems subject to SSO will be governed by the Project Sponsor's SSPP, SSP and the activities and requirements of the SSO agency (SSOA). These include internal audits, triennial safety reviews, triennial security reviews, accident investigations and statistical analysis, configuration management, and conformance with policies and procedures to assure the safety and security of the system's employees, passengers, facilities, and the general public.

FTA Safety Authority

With MAP-21 (49 U.S.C. § 5329) FTA was grant new Public Transportation Safety Authority, providing additional authority to set minimum safety standards and to conduct investigations, audits, and examinations [Ref. 2-2].

CHAPTER 3 – GENERAL MANAGEMENT PRINCIPLES FOR TRANSIT CAPITAL PROJECTS

3.1 Introduction

This chapter presents the general principles for managing the transit capital project development process, emphasizing aspects that are not phase-dependent or that apply to more than one phase, and thus can be applied throughout the project development process. These principles supplement the topics presented in Chapters 4 through 6, which are specifically related to the Engineering Design, Procurement and Construction, and Testing/Start-Up Phases, respectively.

The scope of discussion of these topics applies primarily to larger MCPs, discussed in Chapter 2, but it is also applicable to smaller transit capital projects. Smaller projects have far fewer organizational and financial resources available to address the project management principles, but nevertheless need to define and assign responsibilities as part of their project development process. Any transit project beyond routine capital replacement can be complex and may be the subject of intense public criticism if it is not successfully implemented. Experience has shown too clearly that projects can experience significant cost increases and schedule slippage in the absence of risk-informed, performance-based, and robust project management by Project Sponsors. Therefore, Project Sponsor attention to managing the capital development is extremely important.

While the concept of "project management" encompasses the entire capital development process from system and project planning through operations and maintenance, "construction management" encompasses the Construction phase activities of a transit project. The ***Guidelines*** are intended to define sound management approaches for the entire process of transit capital project development, encompassing both traditional project and construction management functions. No attempt has been made to differentiate these functions within these ***Guidelines*** although a Project Sponsor may find it convenient to establish the role of a "construction manager" to oversee the Construction Phase as well as to provide review and input to the Engineering Phase activities. Agencies may also retain “program managers” to act as extensions of their staff and to oversee all phases of the project. In such instances, the program manager(s) must report to Project Sponsor staff member(s) who are clearly identified in all project documents as the individuals with management and decision-making responsibility.

Professional organizations available as resources to promote the development and practice of project management and construction management include:

- The Project Management Institute (PMI) [Ref. 3-1]
- The Construction Management Association of America (CMAA) [Ref. 3-2]
- The Design-Build Institute of America (DBIA) [Ref. 3-3]
- The Association for the Advancement of Cost Engineering (AACE) International [Ref. 3-4]

PMI addresses project management topics in a generic manner not necessarily related to capital projects such as in the transit industry, while CMAA focuses on issues affecting the construction of capital projects. DBIA is a relatively new organization that supports D/B and other alternative project delivery methods. AACE International serves cost management professionals -- cost managers and engineers, project managers, planners, schedulers, estimators, bidders, and value engineers. All of these organizations have professional development activities and publication resources that can be used to enhance the capabilities of management personnel involved in implementing transit projects.

The Construction Industry Institute (CII) was founded in 1983 to improve cost-effectiveness in construction by identifying needs, conducting research, and publicizing remedies to construction problems. CII is a consortium of leading owners and contractors who have joined to find better ways of planning and executing capital construction programs. A list of CII publications can be obtained from:

☞ The Construction Industry Institute [Ref. 3-5]

Local User Councils (LUCs) that exist in most metropolitan areas gather data on local construction activities and problems, provide a forum for information exchange among agencies and contractors, and sponsor educational programs for project and construction managers. Membership and participation by the Project Sponsor in the nearest LUC is highly desirable. A list of LUCs and their local contacts is available from:

☞ The Construction Users Roundtable (CURT) [Ref. 3-6]

MCPs are complex undertakings that require a formal, risk-informed, performance-based management approach in order to achieve success. To understand the processes involved in managing such projects, it is worthwhile to review some definitions:

- Project – Any series of activities and tasks carrying a specific objective that must be accomplished within certain specifications; having defined start and end dates; having funding limits, and consuming resources such as time, money, labor, and materials.
- Project Management – Planning, supervision, and control of the project.
- Project Planning – The process of creating the clear definition of work requirements, quantity of work, and resource requirements.
- Project Supervision – The management activity that involves a performance tracking process, comparing actual to predicted qualitative as well as quantitative outcomes, analyzing impacts, and making adjustments.
- Successful Project Management – Achieving the project objectives within budget and on schedule and at the desired performance level (plan, specifications, quality), while using the assigned resources effectively and efficiently.

The management philosophy, project team attitude, and application of project resources are critical to the success of any project. They are established and fostered by the Project Sponsor’s project manager and, if effective, permeate the entire project team. For instance, a light rail study in Hennepin County, Minn., included a succinct list of features necessary for the success of capital projects [Ref. 3-7]:

- *Well Defined Project Concept* – clearly defined project concept and mission – what, why, when, and at what cost.
- *Strong Project Champion and Local Public Support* - both public and private sector local support, especially by those most directly affected by the project during construction and operations; strong and effective leadership to develop and maintain project consensus.
- *Timely Implementation of a First Line or Initial Segment* – a successful start-up that maintains public support and provides the basis for future financial commitments.
- *Small Project Management Team* – cost-effective use of consultants to permit simple/direct lines of communication, timely/responsive decision-making, and minimal interference with contractors.
- *Appropriate Risk Sharing* – clear identification and allocation of risks through the Project Sponsor's procurement/contracting policies and procedures.
- *Early ROW Clearance* – the Project Sponsor responsibility, either directly or through separate contracts, for ROW acquisition/clearance, including utility relocation prior to the beginning of construction.

3.2 Project Sponsor and Project Organization

3.2.1 Project Sponsor Authority, Requirements, and Organization

The Project Sponsor responsible for any transit capital project must possess the legal authority to carry out all the requirements necessary to effectively plan and implement the project. Statutory authority may be required to perform functions such as:

- Planning, design, construction, ownership, operation, and maintenance of public transit facilities, equipment and rolling stock
- Local financing, including use of public funds, taxation, and issuing bonds
- Receipt of Federal and state grants
- Procurement and awarding contracts
- Real estate acquisition and condemnation
- Construction in public right of way (ROW) including relocation of utilities
- Safety and security certification of the project including hazard analysis

A review of existing statutes will increase understanding of the Project Sponsor's authority and any legal constraints that may affect the project. The purpose should be to identify requirements and constraints in an orderly and timely manner and to deal with them as the project advances. This is especially critical for projects that are to be built in public ROW, ROW belonging to railroads or state highways agencies. Failure to recognize and accommodate legal requirements may jeopardize the entire project and, at the very least, severely affect the subsequent grant approval process and project schedule, as well as project costs. The Project Sponsor must be diligent in maintaining cognizance of changes in the legislative/regulatory environment, which may impose future constraints on a project. The ability to anticipate and deal with those potential issues in the PD and Engineering phases may save considerable time and effort during construction. In addition to state and local requirements, specific Federal statutes, rules, regulations, and circular listings, include, but are not limited to, the following topics:

- Americans with Disabilities Act (ADA), as amended (42 U.S.C. 12101 *et seq*)
- Brooks Act qualifications-based procurement method (40 U.S.C. Chapter 11)
- Buy America (49 CFR Parts 661 and 663)
- Capital Leasing (49 U.S.C. § 5301)
- Cargo Preferences (46 U.S.C. § 1241)
- Clean Air Act, CAA (42 U.S.C, 7401 *et seq*)
- Copeland Anti-Kickback Act (18 U.S.C. 874)
- Davis-Bacon Act, wage rates and labor provisions (40 U.S.C. § 3141 *et seq*)
- Disadvantaged Business Enterprise, DBE (49 CFR Part 26)
- Equal Employment Opportunity, EEO (49 U.S.C. § 5332b)
- Final Interim Policy Guidance, FTA Capital Investment Grant Program, August 2015
- Financial Capacity Policy, FTA Circular 7008.1A
- Financial Plans as described in FTA's Guidance for Transit Financial Plans
- Flood Insurance as set forth in section 102 of the Flood Disaster Protection Act of 1973
- Land Acquisition and Relocation (49 CFR Part 24)
- MAP-21 (49 CFR Chapter 53, October 2012)
- National Environmental Policy Act, NEPA (42 U.S.C. 4321 *et seq*)
- National Historic Preservation Act of 1966 (16 U.S.C. 470)
- National Pollution Discharge Elimination System, or NPDES (33 U.S.C. § 1201 *et seq*)
- Occupational Safety and Health Regulations (29 U.S.C. Chapter 15)
- Project Management Oversight Rule (49 CFR Part 633)
- Public transit employee protections set forth in 49 U.S.C. § 5333(b), also known as Section 13(c) of the Federal Transit Act
- Rail Safety Improvement Act of 2008 (49 U.S.C. § 20101)
- Rehabilitation Act of 1973, Section 504, accommodations for persons with disabilities (29 U.S.C. § 504)
- Safety and Security Management Guidance for Major Capital Projects (FTA Circular 5800.1)
- State Safety Oversight Rule (49 CFR Part 659)

There is occasionally the perception that State/local laws may conflict with Federal requirements. If one does not defer to the other, the Project Sponsor must comply with both. For example, in real estate, state law may necessitate a payment not mandated by Federal requirements. In such an instance, the Project Sponsor typically must comply with the state law even if such payment is not eligible for Federal grant participation.

When a transit agency undertakes a capital project, the relationship of the agency's project team to the agency's operating, finance, planning, design, construction and other organizational units must be clearly defined and the interface points between them clearly established to achieve scope, quality, cost, and schedule goals. Through its governing board, the Project Sponsor is responsible for performing the following functions:

- Establishing project policy
- Assuring financing of the project
- Approving funding applications
- Approving budgets, commitments, and expenditures
- Approving project scope and definition (design criteria)
- Establishing change control policies and procedures to control scope, cost and schedule creep
- Assuring quality of all end products
- Approving contract documents
- Approving award of contracts and contract changes
- Acquiring land
- Executing the project
- Determining operational readiness and certifying that the safety and security requirements outlined in the Safety and Security Checklist have been fulfilled

A typical Project Sponsor organization will have a chief executive officer (e.g., president, general manager, or executive director) who will implement board policies through the day-to-day operations of the Project Sponsor. Often this individual will be assisted by heads of departments such as engineering, construction, real estate, finance, procurement, legal, personnel, operations, safety, security, and public affairs. Taking into account the Project Sponsor's organization, the project to be implemented, and the Project Sponsor's future role and responsibilities in the new project, there are a number of successful organizational approaches with regard to staffing the project. These include:

- Developing or reassigning an in-house staff (with prior successful track record with similar projects) to a project office to undertake the entire project. This in-house staff organization may be augmented by a PMOC or project advisor to assist in providing independent advice or analysis to senior management.
- Utilizing existing third-party agencies (with prior successful track record with similar projects) such as another transit agency or state or local government agencies to perform the work under a third-party contract. This third-party organizational arrangement may be augmented by a project management oversight consultant or project advisor to assist in providing independent advice or analysis to senior management.
- Under the dedicated management team with sufficient resources to oversee and supervise a consultant(s), delegating responsibility to a general consultant for planning, designing, and constructing the facility, or assignment of the management of design, and construction to separate consultants. Consultants must have a successful track record.
- If the Project Sponsor does not have adequate and dedicated management resources to oversee the general consultant, Project Sponsor can delegate the responsibility of project management to a program/project management consultant.

- Utilizing contractors for alternative project delivery methods, such as D/B, D/B/O/M, and concessions.
- Combinations of the above approaches.

No matter which organizational approach is chosen, the Project Sponsor has the ultimate responsibility for the effective management of the project. The project staff may typically be organized in a matrix form of organization delineating engineering and construction activities. The matrix must clearly indicate which Project Sponsor staff member(s) are responsible for overseeing and supervising any non-Project Sponsor (i.e., contractors, consultants, etc.) activities. A matrix organizational form is often defined with multiple reporting relationships as further explained below.

Figure 3-1 depicts a matrix organization in which line departments with functional responsibilities are shown vertically and project organizations with project responsibilities are shown horizontally. In such an organization, a staff person has dual reporting responsibilities to the functional manager and to the project manager. Figure 3-2 further develops this concept to define the project office into which staff can be assigned on a temporary basis while remaining functionally affiliated. This matrix organization is utilized on finite duration projects, such as MCPs, where dual focal points of equal importance are required – technical/scope and cost/schedule. Personnel assigned to the project report to the project manager regarding work priorities (what must be done and when), and to a functional manager for the technical adequacy (how work is to be done). The matrix form of organization permits the integration of technical specialists and firms that may participate on several individual tasks to contribute effectively, along with others, to the accomplishment of the project objectives for which the organization is responsible.

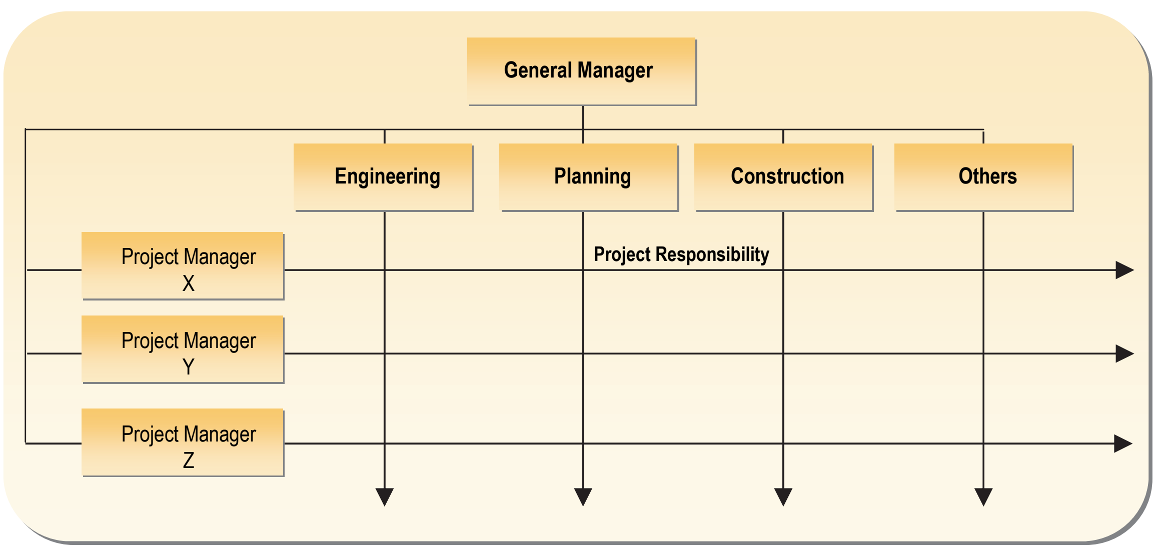


Figure 3-1. Matrix Organization

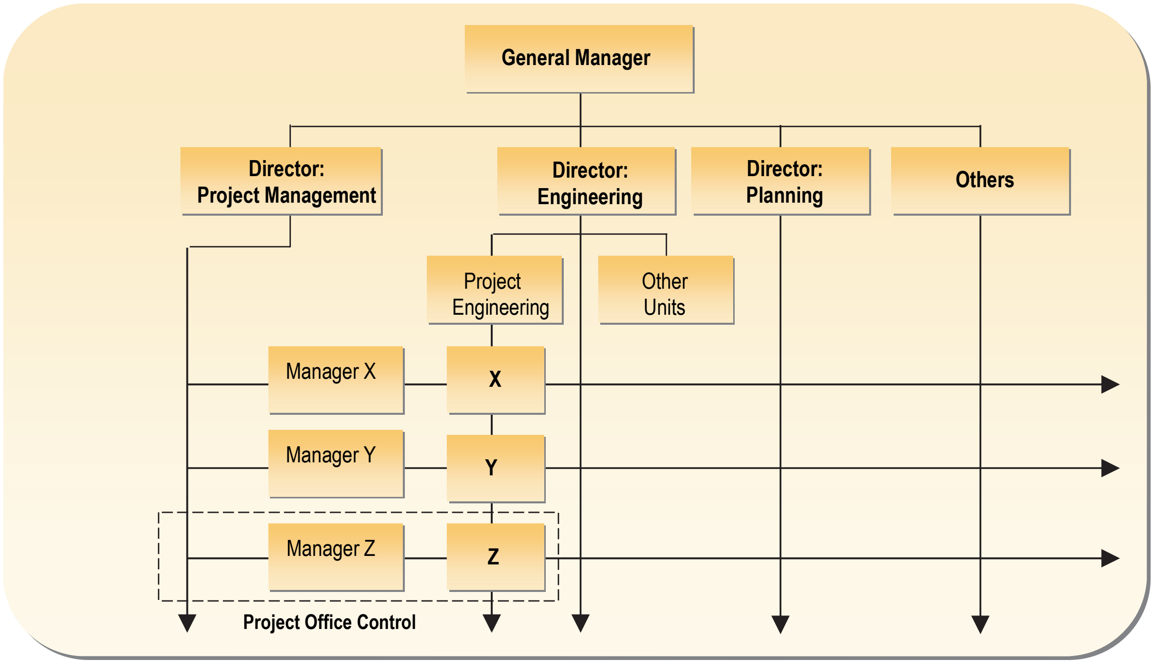


Figure 3-2. Matrix Organization with a Project Office

As a transit capital project, particularly an MCP, evolves throughout its phases from planning to implementation, it will refine its objectives and vary its organizational participation, depending on the specific requirements of each phase. Thus, the project management framework must be flexible to accommodate the needs of each phase.

3.2.2 Project Organization, Staffing, and Training

The goal of the project organization should be the effective and efficient accomplishment of the project objectives for each project phase. This may necessitate the involvement of different personnel and contractors from phase to phase and may even warrant different lead public agencies and project managers.

As a project evolves, however, there is a need for continuity to assure the achievement of its overall objectives. Critical in the structuring of any organization is the flow of authority and responsibility from the Project Sponsor through the project manager, functional area managers, and contractor managers to each assigned project participant. Variations in the size and complexity of transit capital projects and the capability of the individual Project Sponsor will influence the need for outside consultants and contractors within the project's organizational structure.

The size, qualifications, and availability of existing staff resources must be considered in relation to the human resource requirements and duration of the project. For the small bus operator planning a new maintenance facility or the transit system developing a single fixed guideway segment, it may be prudent to contract for technical studies, design, and project management services, rather than hiring an entirely new or greatly expanded staff. In the case of a large fixed guideway system development, a project may employ consultants initially, until in-house staff capabilities are developed gradually to the point that they can replace the consultants. Agencies also have the option to assign greater responsibility to contractors by utilizing alternative project delivery methods.

The obvious benefit of using contracted support services for a project of finite duration is the ability to terminate their involvement and associated expense when the project is completed. Even when an outside organization is used, the Project Sponsor must have in place its own qualified organization to maintain overall control of the project, provide timely decision-making, and maintain appropriate communication channels with all project participants and stakeholders. Clearly, Project Sponsors should avoid any organizational structure that results in duplication of effort, or that would tend to undermine authority. The organizational structure and work scopes for both Project Sponsor staff and outside contractors must clearly define their respective responsibilities.

> **Integrated Management Teams**
>
> *Teams for the management of major projects must be compatible with the existing Project Sponsor organization. Oftentimes they have been set apart from the agency and its support staff (and even, sometimes, its design and operations functions) only to cause unnecessary friction and an inability to take advantage of existing management and control systems. Particularly when the project management team includes the key management and staff of the eventual operator, a failure to integrate the Project Sponsor general management and administrative functions and staff misses economies, synergy and the gaining "ownership" by those who will ultimately be operating the completed project.*

Organizing and staffing during each of the project development phases should adhere to the following guidelines, which should be addressed in detail in the Project Management Plan (PMP). Charts should be developed for each phase and should cover all project functions. These charts should identify key personnel in all organizations and clearly define their principal duties, reporting relationships, assigned responsibilities, and delegated authority. Staffing utilization and commitment levels should be indicated (as percent of full time equivalent), and job qualifications provided. The organization chart could be presented as or supplemented with a tabular staffing plan that shows percent utilization, mobilization start date, and release date (where applicable) information.

- Interface points within and outside the project organization should be identified.
- Project Sponsor and contractor organization charts showing the organizational placement of personnel assigned to the project and the interface points should be required for all major project participants.
- A staff mobilization plan that incorporates a schedule of milestone events should be developed.
- The philosophy governing the development of the project organization should be stated and the decision to use contractors or in-house services should be explained.

Delegations of Authority

Delegation of authority levels need to be established by the Project Sponsor at the outset of the project. These delegations must also recognize the numerous changes the agency will face during the life of the project. It is wisest for a Project Sponsor to adopt the principle of "authority at the level most knowledgeable and aligned with the responsibilities."

Delegations of authority should promote transparency in the making of decisions. Everyone with a responsible charge for making decisions should be accountable for his or her actions, and these actions must be based on clear documentation, sound analysis, and an understanding of their consequences. Contract amendments as well as change order dollar values can and should be assigned to the level most appropriate to deal with and approve the changes.

Assigning levels of authority and dollar value restrictions on that authority can be used to efficiently deal with changes, keep contractors on schedule, and mitigate claims. Each agency/authority may need a differing level of change authority delegation.

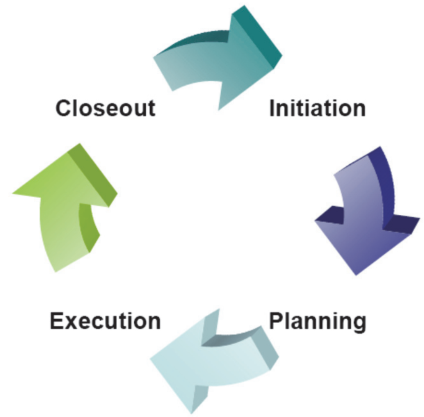
It should be recognized that for large, multi-segment, fixed guideway projects (new construction or modernization), a Project Sponsor may simultaneously be in varying levels of project development on individual system segments. Detailed project organization charts should be prepared for each phase to show all of the participants and their reporting relationships.

Project management should be sensitive to the appropriate human resource and training needs of the project team members in the unique aspects of the project being undertaken. In-house staff may need to be exposed to training on implementation of new project delivery techniques such as D/B, turnkey and D/B/O/M. The Project Sponsor should include specific staff management capabilities and training requirements in contract documents. Areas of training could include:

- Issue resolution, elevation and communications protocol
- Project control requirements
- Project team roles and responsibilities, especially with non-conventional project development approaches
- Project partnering
- Claims avoidance techniques
- FTA guidance for managing MCPs
- Environmental sensitivities and mitigation requirements
- Construction safety awareness and related risk insurances
- Contract packaging and delivery method(s)
- Construction security awareness and breach reporting procedures
- Community impact mitigation requirements and approaches
- Safety, security, and operational concerns when working adjacent to an existing fixed guideway transit system

3.2.3 Work Breakdown Structure

The Project Sponsor must establish a detailed WBS, which is a deliverable-oriented hierarchical decomposition of the work to be executed by the Project Sponsor and/or program team to accomplish the project objectives and create required deliverables. The WBS subdivides the project work into smaller, more manageable pieces of work, with each descending level of the WBS representing an increasingly detailed definition of the project work. The planned work contained within the lowest-level WBS components (work packages) can be scheduled, cost estimated, monitored, and controlled.



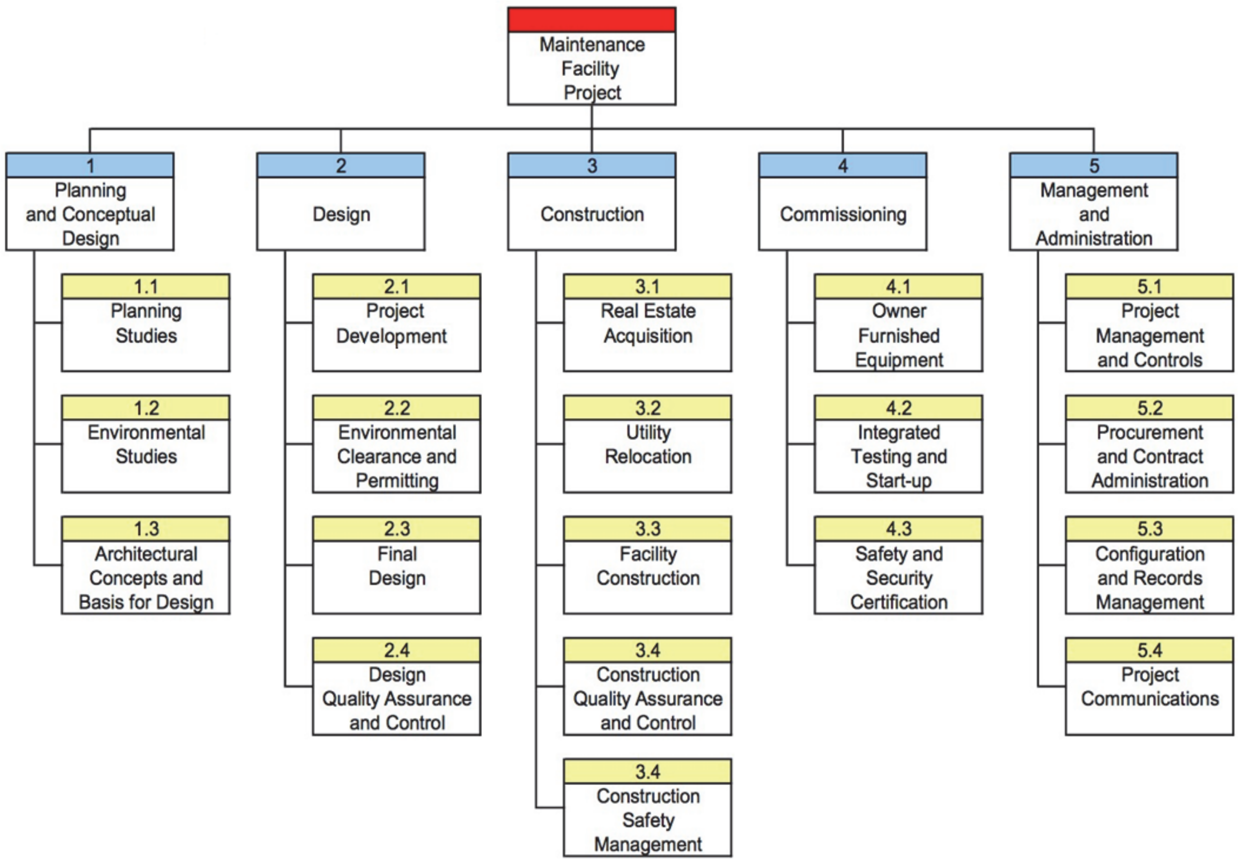
The WBS:

- Provides a framework for organizing all of the work and managing approved project scope
- Provides a traceable and easily identifiable record of work and can be used as a check-tool to ensure all work is captured
- Provides a framework for planning, monitoring and controlling the program scope, schedule and cost

The WBS should include all project management life-cycle phases, from project initiation to project closeout, well after revenue operations are underway. Likewise, the WBS should include the decomposition of work required of all parties on the program. Such parties include the Owner, supporting Federal, state and local agencies, funding partners, consultants, contractors, and vendors. All FTA requirements, guidelines, and deliverables should be clearly established in the WBS; especially permits, environmental documents; deliverables and other critical items that require third-party review and approval.

The WBS taxonomy can be classified in a multitude of categories such as geography, management oversight group, project delivery methods, contract packaging, minimal operable segment (MOS), funding source, etc. It is normally prepared in a hierarchical or multi-tiered fashion with the lower tiers being defined during design and project execution. A number or alphanumeric identification is assigned to every WBS element.

The WBS should be developed to meet the needs of project management, not merely the needs of the control functions or other specialties. A hierarchy of system physical components should be established either within the WBS or separately so that work packages applicable to each configuration item can be identified and followed. Tasking in the PMP or other project master or subordinate plans should be to WBS elements [Ref. 3-8.]. For example, Figure 3-3 depicts a simplified WBS for a maintenance facility project.



In a complete WBS the above work elements would be broken down into more detailed work packages. For example: WBS 1.1 Planning Studies could be broken down further into 1.1.1 Functional Studies, 1.1.2 Site Selection, and 1.1.3 Technical Studies; and WBS 2.3 Final Design broken down further by design package into 2.3.1 Utility Relocations, 2.3.2 Facility Structure, and 2.3.3 Major Equipment Procurement and Installation.

Figure 3-3. Example of a WBS

Breaking down work into packages through a WBS makes it easier to manage a multifaceted undertaking such as a transit project. The Project Sponsor and the project manager must use care in applying WBS techniques only to those situations where there are sufficient supervisory personnel representing the Project Sponsor to monitor and control scope, schedule and cost performance of each package.

Where multiple organizations are working on the same task, the Project Sponsor will need to establish an Organization Breakdown Structure (OBS). In such cases, the Chart of Accounts will be established using the WBS and OBS information.

In summary, the WBS must represent a breakdown of work that is manageable and meaningful, ultimately serving also as a historical record that can be used for initiation of the next project phase and delineating the changes to and current status of scope, schedule, and budget. The WBS must designate the organizations that perform the work.

A final note: In 2005, FTA implemented the Standard Cost Categories, to establish a consistent format for the reporting, estimating, and managing of capital costs for New Starts (NS) projects. The cost information gathered from projects across the country are being developed into a database and become a cost estimating resource useful to FTA and the transit industry alike. The SCC Workbook is a project management tool -- project-based as opposed to grant-based. Consequently, all Project Sponsors should, from the outset of capital cost estimating, develop their estimates using the WBS while simultaneously populating the SCC formatted budget with data from the same source. See FTA's Standard Cost Categories (SCC) for Capital Projects. [Ref. 3-9]

Over the life of a project, the consistent WBS format tied directly into the SCC format should make it easier to track, evaluate, and control cost changes. Submission of capital costs to FTA in the SCC format is required at the following points:

- Request to enter PD
- Request to enter Engineering
- Request for Full Funding Grant Agreement (FFGA)
- Request for Small Starts Grant Agreement (SSGA)
- Submission for Annual NS evaluation
- FFGA and SSGA amendments
- During construction at regular intervals
- At revenue operations
- Annually until the later of the submission of the Before and After Study or at project close-out and resolution of claims

3.3 Financial Requirements/Resources

For a project to be viable, it is important that it be based upon realistic cost estimates and a credible plan for financing both the capital and O&M costs. Historically, in many situations, capital costs for transit projects have been funded by a combination of Federal government (FTA) and matching funds provided by state and local government sources. Operating costs have traditionally been funded partially by farebox revenues with other major support coming from Federal, state, and local government taxes or other dedicated revenue sources.

FTA encourages Project Sponsors to consider a number of creative financing arrangements, including private sector participation, to support both capital and operating costs and, in some cases, project implementation, and ownership. As the funding sources for transit projects become more numerous and complex, Project Sponsor management of them becomes more important. FTA's guidance to Project Sponsors on private sector participation is contained in its third-party contracting guidance (FTA Circular 4420.1F) [Ref 2-21], which provides contracting and procurement guidance for recipients of Federal assistance awarded by FTA when using that Federal assistance to finance its procurement (third-party contracts). The Circular also promotes private sector participation by simplifying project implementation by analyzing procurement plans.

Furthermore, as Federal funding is subject to annual appropriations, Project Sponsors must develop alternative plans in case the Federal share is reduced or delayed.

☞ Guidance for Transit Financial Plans [Ref. 2-44]

FTA provided the guidance referenced above regarding the development of Project Sponsor financial plans. These plans are to adhere to the outline set forth below. Key issues related to the elements of the financial plan are discussed in the following sections and included in Figure 3-4.

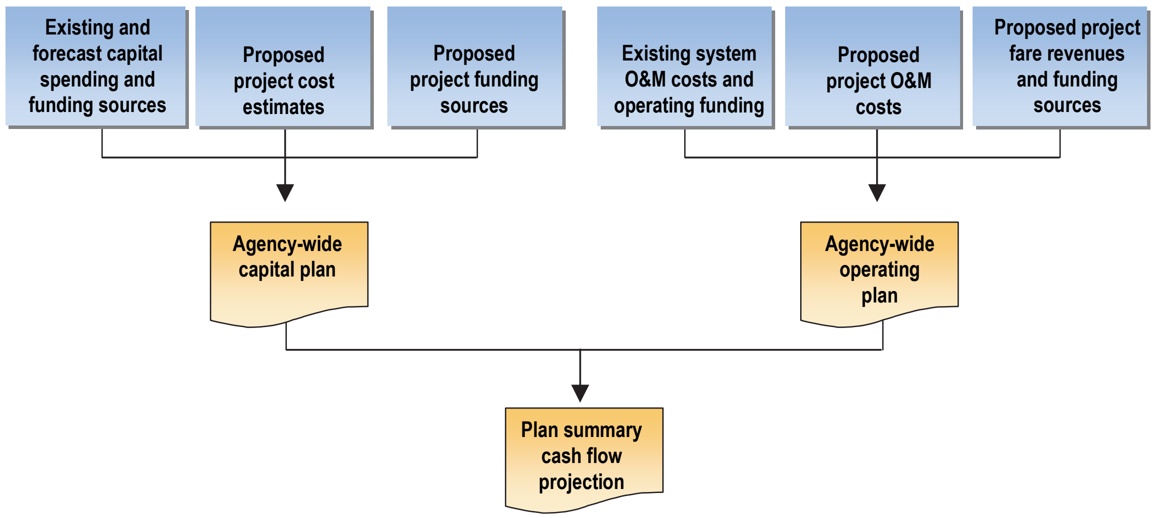


Figure 3-4. Components of a Financial Plan

3.3.1 Capital Plan

The first element of the financial plan is the capital plan, which documents the Project Sponsor's capital spending plans and funding sources and describes in detail its plan to fund the construction of the proposed project. The capital plan is composed of three elements: (1) The Project Sponsor's 20-year forecast capital spending and funding sources, (2) the proposed project cost estimates expressed in year of expenditure (YOE) dollars, and (3) the proposed project funding sources. The capital plan documentation should confirm the stability, reliability, and availability of all capital funding sources and describe the Project Sponsor's capital spending plans 20 years into the future.

3.3.1.1 *Project Capital Plan*

FTA requires a cost estimate and schedule at each phase of the project process cycle, although the format of the cost estimate changes. In PD Phase, project cost estimates and schedules present data in unit cost breakdowns of the proposed project. When a project proceeds to Engineering and the Project Sponsor seeks an Full Funding Grant Agreement or before Small Starts Grant Agreement, the cost estimates are allocated to specific contracts and are based on quantity takeoffs and unit prices of WBS components that can then be tracked and periodically updated as the project continues through the design and construction process. All costs should be presented in the FTA SCC categories.

Capital cost deliverables describe the cost estimation process and segment costs by major cost category (e.g., guideway, facilities, systems, and vehicles). Cost estimates include soft-costs such as the following:

- Real estate/ROW acquisition and relocation
- Utility relocation
- Project management
- Engineering, design, and specialized studies
- Third-party reviews and permitting fees
- Construction management
- Environmental impact mitigation
- Public involvement
- Testing and start-up
- Insurance
- Project financing
- Contingency allowances
- Escalation from the date of the estimate to the date of implementation

The capital plan should document the current cost estimate for the proposed project, describing each major cost component. In early PD, this can be a simple cost estimate, including high contingencies to reflect uncertainties in scope, which can be used for the financial plan. At the end of PD, the scope of the project should be more accurately determined and additional detail should be added to the cost estimate, forming a project budget that matches up with the project description and forms the Basis for Design. This Project Budget should conform to FTA guidance provided in a workbook that collects and assembles the capital costs into FTA Standard Cost Categories (SCC) format, as well to the Project Sponsor's planned contract units established through the establishment of a definitive contract packaging method. Before entry into FFGA or SSGA, the project budgets should be baselined based on project scope and schedule.

FTA's Standard Cost Categories (SCC) for Capital Projects [Ref. 3-9] contains an SCC format sample project budget that all Project Sponsors, and MCP Project Sponsors in particular, must use at the entry to each project phase. This same reference [Ref. 3-9] also demonstrates the translation of a Project Sponsor cost estimate into SCC format. The Project Sponsor should keep in mind that the budget format used must be directly correlated and accurately represented in the SCC format.

Construction cost indices are useful in estimating costs. Two national sources for cost indices are *Engineering News Record* and *F.W. Dodge Reports*, both of which are published by McGraw-Hill, Inc. Various construction groups typically publish local cost data. State agencies and associations publish unit cost data for various construction items. These data are beneficial because local labor rates for various crafts are used, together with labor availability in the area. However, in many instances, they fail to account for some of the cost line items that are unique to transit projects.

FTA has developed a Capital Cost Database through which costs are tracked in the FTA's SCC framework and the costs validated by the Project Sponsors. This database is available online and added to regularly [Ref. 3-10].

Additional FTA studies of transit capital costs have documented actual costs by categories for several transit projects:

- Light Rail Transit Capital Cost Study [Ref. 3-11]
- Fixed Guideway Capital Costs, Heavy Rail and Busway/HOV Lane [Ref. 3-12]
- Transit Capital Cost Index [Ref. 3-13]

These studies provide cost information for labor, materials, and equipment, as well as normalized cost data to account for cost differences by project date and city. Referring to these studies will also assist transit agencies in developing local cost estimates by cost component.

Internal FTA White Paper: Cost Estimation Methodology

Cost estimation is a process that provides progressively more accurate information as a project moves from concept through Final Design and awarding of Construction contracts. It establishes initial budget limits and is the crucial element of a project management/control system. FTA relies heavily on a grantee's ability to develop and monitor an accurate project budget. Over time, budgets should be refined as more detailed engineering information becomes available. The White Paper provides several cost estimation recommendations (see Appendix A).

The capital cost estimates should initially produce data in present day dollars and then escalate them to the year-of-expenditure (YOE), using distinct inflation forecasts for, at a minimum, material and equipment costs, ROW acquisition, labor cost, and general price inflation. The *Transit Capital Cost Index* report contains information on inflation indices. Costs in constant dollars should be budgeted according to the construction schedule. These costs should then be escalated to the year of expenditure. The SCC Workbook provides, at the worksheet tab entitled "Inflation", a formatted spreadsheet Project Sponsors are encouraged to use to calculate YOE costs based upon the project cash flow. For more detail, refer to:

- Federal Transit Administration - Standard Cost Categories (SCC) for Capital Projects [Ref. 3-9]

During Engineering, Project Sponsors usually break projects into contract units or packages, each with a distinct schedule and cost estimate and a specific contingency amount allocated to each contract at the time of award. An unallocated contingency amount should be maintained at the project level. The initial escalated cost estimate divided into contract units is, as mentioned above, called the Baseline Project Budget and is developed by the MCP Project Sponsor before an FFGA is signed. This estimate may be derived from estimated contract costs escalated to year-of-expenditure (generally at the mid-point of construction but sometimes even more specific with respect to at least the anticipated quarter in which expenditures will be booked). Each contract will be awarded and tracked by the Project Sponsor throughout the Construction phase.

The cost estimates may change as bids for each of the contracts come in higher or lower than the Baseline Project Budget has projected. If the contingency funds (allocated and unallocated) are not sufficient to accommodate higher bids and future project risk, changes to project scope and contract amendments may be required to stay within budget. The Project Sponsor should track these changes in project costs on a separate schedule that provides the current budget forecast for the project. As the current budget forecast changes, the capital plan may need revisions to ensure that the Project Sponsor maintains a sound financial position. Project Sponsors are subject to financial spot reviews by FTA and its PMOCs to ensure that they have the financial capacity to complete the project according to the terms of the FFGA, as well as to operate and maintain the existing transit system and service levels.

It is imperative that Project Sponsors carefully undertake any and all proposed changes in project scope so as not to compromise the project definition enunciated in the project's Final Environmental Impact Statement (FEIS) or FEIS associated programmatic agreements, or jeopardize the provisions of the FFGA or Master Agreement.

3.3.1.2 *Force Account*

Capital project work conducted by Project Sponsor in-house forces to support the work of private contractors is classified as "Force Account" by FTA Circular 5010.1D [Ref. 2-29]. Force Account work is eligible for Federal funding if properly documented and "warranted" in terms of:

- Cost savings
- Exclusive expertise
- Safety, security, and efficiency of operations
- Union agreements

Control of Force Account Schedules & Budgets

Rail transit agencies have undertaken major capital improvement programs that meet the criteria for Force Account Work, while maintaining nearly normal passenger service. In order to integrate the Force Account budgeting and scheduling with the agency's, the agency may need to establish or designate someone within its Operating Division to monitor the costs and provide the necessary focus for coordination of Force Account and contractual work. The agency needs a process for formalizing the scheduling, documentation, analysis, and methods of communication between the managers of capital programs and operations.

3.3.1.3 *Subsequent Modernization Cost*

The estimated cost to periodically modernize and replace capital equipment and facilities is considered a capital expense. A sound financial plan should include this cost to assure that the resources will be available to maintain the capital investment. The estimated cost should be based on replacement cycles for the various elements. A capital replacement or sinking fund with regular contributions could be used to assure that funds will be available. Such a fund could also be used for needed capital modernization or as a match for an anticipated state or Federal grant.

3.3.1.4 *Contingencies*

Cost contingencies provide reserves against the risk of cost increases during the development of the project. These contingencies must be separately identified in the project's financial plan and included in the capital cost estimates. The capital cost documentation should include a description of all the cost escalation risks and identify the range of potential cost impacts. Contingencies can be established as a specific amount or as a percentage of a budget estimate to cover (or both):

- Areas of the budget estimate not fully defined as well as cost and quantity uncertainties
- Escalation which exceeds that predicted for material, labor, equipment, services, and rates of exchange
- Overruns in items of time and cost during project execution
- Unforeseen or changed conditions, design revisions, and estimating inaccuracies

As a project moves through the engineering and design processes, cost increases due to the refinement of design are less likely and, consequently, the contingency should be reduced. Typical working targets for total contingencies start in the 30 to 40 percent of project costs range in the early project development phase drop further to approximately 25 percent at entry into Engineering, and, at completion of design, total contingencies will typically have a working target of approximately 15 percent and even that may be reduced after construction contracts have been signed. At approximately 90-100 percent bid for the Project Sponsor, or 90-100 percent subcontracted for the prime contractor in an alternative project delivery method, the working target for total contingency is approximately 10 percent. At approximately 50 percent physically complete for Construction, the working target for total contingency is at least 5 percent. It would then be prudent, given experience with Testing and Start Up Phases and close-out of project contracts, to hold that 5 percent total contingency through completion of the project. These are, however, generalized contingency levels that should be analyzed and amended based upon actual project conditions.

After an FFGA is signed, the Project Sponsor is responsible for any cost increases and for fulfilling the terms of the FFGA. Reduced service, delayed construction, or reductions in project scope are not acceptable contingency plans, unless pre-approved by the FTA and not inconsistent with the terms of the FFGA.

3.3.1.5 *Capital Funding*

FTA NS funding is provided through 49 U.S.C. 5309. Section 5309 funding also supports fixed guideway modernization, bus, and bus related projects. Other capital funding sources include the Urbanized Area Formula Program (49 U.S.C. 5307), Non-Urbanized Area Formula Program (49 U.S.C. 5311), and Flexible Funding Transfers. Flexible funds can be used for highway, transit, or other transportation projects, as determined by the regional MPOs and state governments. Examples of such funds are the Surface Transportation Program (STP) and the Congestion Mitigation and Air Quality (CMAQ) funds. A number of transit agencies have been successful in tapping into these flexible funds for transit projects.

Given that the availability of FTA funds is limited and the demand is high, it is advantageous to have in place a capital plan that identifies all potential sources of funding, including non-FTA Federal and non-Federal sources.

The project capital plan must identify the proposed sources of funds for constructing the proposed project and detail the non-Federal share of project costs. The information submitted regarding funding sources should provide documentation for FTA to determine the degree of commitment of each funding source and to help ensure that local match requirements are met. As the project advances in the development and implementation process, the required level of commitment of non-Federal funds should increase. A financial plan must identify a "realistic" funding plan for providing the local share. The Project Sponsor must also demonstrate that the funds required for Project Development are Committed as defined by FTA in its Guidelines and Standards for Assessing Local Financial Commitment [Ref. 3-14]. During PD, the Project Sponsor is expected to secure committed funds so that a significant portion of non-Federal funds is committed before the project may advance to Engineering. All non-Federal funds must be formally approved and programmed to fund the non-Federal share of the proposed project before FTA will recommend or approve a project for a grant.

The capital plan must summarize the non-Federal and Federal shares of project costs and provide evidence of funding commitment. Such evidence of commitment may include legislative documentation, resolutions approving funding, account balances, a bonding prospectus and Project Sponsor debt covenants, signed joint development agreements, and legally binding agreements with state/local agencies committing funds.

The text accompanying the capital plan must clearly identify all local, state, Federal, and private funding sources, including the name, originating level of government, total dollar amount anticipated, amount currently expended, and the share of total project capital costs in year-of-expenditure dollars. The total dollar amount across funding sources must equal or exceed the project's total capital cost, including total (i.e., allocated and unallocated) contingencies. Before entering into an FFGA, FTA will utilize a financial consultant to review and provide an assessment of the Project Sponsor's financial capacity.

3.3.1.6 *Alternative Funding Source*

As competition has increased for the limited amount of Federal funds, FTA has encouraged transportation entities to seek alternative funding sources for transit services and facilities. These and other alternative non-Federal transportation funding sources can be used to fund project capital and O&M costs. Candidate techniques have been documented in:

☞ Alternative Financing for Urban Transportation, posted at the DOT's National Transportation Library website [Ref. 3-15]

These are listed below with locations in which their application has been studied:

- Taxes
  - State Sales Tax and Sales Tax on Fuel (State of California)
  - Motor Vehicle Excise Tax (State of Washington)
  - Local Option Transportation Taxes (State of Florida)
  - Sales Tax (Maricopa County, Arizona)
  - Beer Tax (Birmingham, Alabama)
  - Payroll Tax (Portland, Oregon)
  - Tax Increment Financing (Prince Georges County, Maryland)
  - Lottery (State of Pennsylvania)
- Assessments
  - Transit Assessment District (Denver, Colorado)
  - Special Benefit Assessment District (Los Angeles and Miami)
- Fees
  - Transit Impact Fee (San Francisco, California)
- Negotiated Investments
  - Development Bonuses (New York, New York)
  - System Interface Program (Washington, DC)
  - Transfer Center Investment (Portland, Oregon)
- Private Donations and Initiatives
  - Merchant Subsidy (Cedar Rapids, Iowa)
  - Bus Shelter Development (St. Louis, Missouri)
  - Transportation Corporations (State of Texas)
  - Rail Station Construction (Secaucus, New Jersey)
- Use of Property and Property Rights
  - Joint Development Program (Washington, DC)
  - Joint Development of Transportation Center (Cedar Rapids, Iowa)
  - Negotiated Land Leases (Tacoma, Washington)
  - Leasing Facilities (Santa Cruz, California)
- Private Development and Provision of Facilities and Services
  - Privately Financed People Movers (Tampa, Las Vegas, and Irving, Texas)
  - Contracted Bus Service and Maintenance (Johnson County, Texas)
  - Contracted Transit Service (Snohomish County, Washington)
  - Transportation Zones (San Gabriel Valley, LA County, CA)
- Public Private Partnership in Fixed Guideway Corridor Development
  - Rail Transit Corridor Development (Fairfax County, Virginia)
  - Corridor People Mover Development (Orange County, Florida).

3.3.1.7 *Financing Techniques*

In addition to traditional and alternative funding sources, transit agencies also have available a number of alternative financing techniques which can help to pay for capital projects and/or which can smooth over an uneven or discontinuous flow of funds from the ultimate funding sources. For more information on these techniques, refer to:

- FTA's *Introduction to Public Finance and Public Transit* [Ref. 3-16]
- The Grant Programs page at the FTA website [Ref. 3-17]

The potential savings that can be realized by using capital market borrowing can speed up acquisition or construction schedules and thus avoid some of the impact of inflation. The financial markets provide financing instruments that can be used by transit agencies to borrow funds both to smooth the flow from funding sources, and to allow project schedules to accelerate. FTA will support tax-exempt transit financing through advanced construction provisions of the Federal Transit Act as amended. The use of alternative delivery techniques such as concessions can also provide the combination of delivery and financing risk transfer.

Under advanced construction authority, FTA may approve a Project Sponsor's use of local funding for a capital project prior to receipt of FTA capital grant funds. Advanced construction can be used when the Project Sponsor can demonstrate cost savings that come from advanced funding of a project. Any source of local funds can be used, including cash, loans, short-term notes, or bonds. Interest costs are eligible for FTA reimbursement. Advanced construction is a tool to overcome cash flow constraints.
Following are some of the financial instruments available to transit agencies for borrowing the funds needed for advanced construction or to handle other cash flow shortfalls:

- *Bonds and Notes:* Typically, Revenue Bonds for transit projects are relatively long-term and secured by specific revenues such as a transit-dedicated sales tax. For most long-term bonds, the issuer of the bonds agrees to pay the holder a specified rate of interest and the principal on the bond at a specified time. Variable-rate bonds are also used; they will normally have shorter terms and require guarantees from reliable financial institutions.
    - *Bond Anticipation Notes* are issued to provide an interim source of financing for a project that will eventually be financed through a bond issue. Tax and Revenue Anticipation Notes (RANS) are issued in anticipation of tax receipts and other revenues.
    - *Grant Anticipation Notes* (GANs) or RANs are issued in anticipation of grant funds. They are a type of revenue bond authorized by MAP-21. Both the principal and interest are eligible for FTA capital funding. Typical terms range from one to fifteen years.
    - *Tax Exempt Commercial Papers* (TECPs) have a maximum maturity of 270 days and are generally used until permanent financing for a program can be obtained.

  Be aware that the Project Sponsor must have that capacity for planned debt prior to an FFGA.

3.3.1.8 *Funding Source Forecasts*

For each funding source, the capital plan must clearly indicate whether the source is an existing source, such as an active local tax from which revenues are currently collected, or a new source requiring legislative approval, referendum, or other governmental action. For existing sources, the plan should outline the conditions of the funding agreement (e.g., funding formula, percent share of total revenues, etc.) and should provide at least five years, but preferably ten, of historical revenue data, including the amount available for transit uses. For major funding sources (sources that contribute more than 25 percent of the agency-wide or NS project capital or operating funds), the plan must include 10 years of historical revenue data. For new sources, the plan must indicate when legislative approval or public referendum is expected and the date the source of funds would become effective. For all sources, the plan must contain a 20-year revenue forecast, documentation of any sunset clauses, and provisions to cover project funding beyond the sunset date.

For all revenue projections, the financial plan must be based on conservative rates of growth that do not exceed historical experience for that source.

3.3.1.9 *Borrowing, Debt Levels, and Ratings*

If the financial plan includes debt, it must include a debt proceeds and debt-servicing plan within its documentation. This schedule presents outstanding debt levels, the gross amount, net proceeds, and bond rating of each debt issuance, debt service requirements, and interest rates for the past five years and 20 years into the future. This schedule should identify, on a yearly basis, the most restrictive debt covenant of the Project Sponsor, such as debt service ratio requirements, outstanding debt ceiling, or limits on debt expenditures during a specific time period. In addition, the most recent bonding prospectus must be included as supporting documentation.

3.3.1.10 *Federal Funding Shortfalls*

The Federal share of the NS project amount is locked in at entry into Engineering. Project Sponsors should be prepared to move the full scope of the project forward even if Federal funds are less than expected. Evidence of financial capacity to provide additional non-Federal funds could be in the form of cash balances, additional debt capacity, or commitments of additional funds from new or existing funding sources. Service reductions and deferred maintenance within the exiting public transportation system for the metropolitan area are <u>not acceptable</u> methods of freeing up additional funds.

After an FFGA has established the Federal share, Federal appropriations may fall short on an annual basis. For instance, the Federal commitment to the FFGA funding levels may be satisfied over six years rather than a planned four-year period. To accommodate this, the capital plan should present alternatives for implementing the project if the annual appropriations are less than planned, including short term financing to cover annual funding shortfalls. The capital plan should show adequate cash reserves, construction reserves, or debt capacity to complete the full scope of the proposed project if annual appropriations are lower than expected. Service reductions on the existing system, construction delays, or reducing the scope or features of the project are not acceptable methods of providing additional funds.

3.3.1.11 *Agency-Wide Capital Plan*

The components of the project capital plan should be summarized and incorporated into the agency-wide capital plan. The Project Sponsor plan must present capital funding and spending for each individual funding source and each individual capital project for the past five years and those planned for the next 20 years. Capital plan documentation is expected to include project names and descriptions, total capital costs and schedules, and proposed Federal funding contributions for each existing, proposed, or planned project. Projects included in the long-range plan and transportation improvement program for the metropolitan area should be identified. The agency-wide capital plan also should include bus and rail fleet acquisitions, replacement, and major rehabilitation consistent with the fleet management plans prepared by the Project Sponsor.

3.3.1.12 *Project Budget*

The PMP is required to contain a budget for the project that must include both hard and soft costs, including those noted above.

While most transit projects have used other internal systems for tracking costs, they have had to translate these costs into the FTA grant management system to meet FTA reporting requirements. This FTA reporting requirement should be taken into consideration, along with the SCC format requirement, when developing the cost reporting schemes for the project.

3.3.2 Operating Plan

The Project Sponsor must supply an operating plan to document how the Project Sponsor intends to fund and operate the proposed project and the existing transit system. The operating plan must document five years of historical data and present 20 years of projected system operating revenues and O&M costs to demonstrate the capability of the Project Sponsor to operate and maintain the proposed project while retaining existing levels of transit service.

The Operating Plan should include the following information:

- A description of the Operating Agency, indicating whether the Project Sponsor or a separate Agency will be responsible for operations, whether operations and/or maintenance services will be contracted to a service provider and the extent of such contracting, if planned
- A description of the system, including the type of service (LRT, heavy or rapid rail, commuter rail, BRT, etc.), ROW, stations (including platform lengths), signal and traction power systems (if any). If the system has a rail component, indicate whether there are joint operations with freight, intercity rail or any other rail carrier
- A description of the vehicle and accessibility plan for individuals with disabilities

- Describe the operating characteristics of the proposed vehicles
- For both opening day and design year, state proposed hours of operation, service frequency, peak, off-peak, weekend and holidays
- Travel times, both end to end and between all stations/stops. Indicate station/stop dwell times and maximum operating speed
- Ridership levels, peak, off-peak, weekend and holidays for both opening day and design year
- Proposed operating schedules, opening day and design year. Discuss simulation studies (if any) that support operating schedules
- Projected peak ridership loading compared to vehicle loading standards for both opening day and design year
- Describe operating crew plan, central control and dispatching plan
- Passenger fares and fare collection methodology. Describe daily, weekly, monthly, multi-trip, peak, off-peak, senior, disabled, and promotional fares. Describe fare collection system and enforcement method
- Describe vehicle storage facilities and vehicle maintenance facilities
- Describe vehicle and ROW maintenance plans. Identify facility, equipment and staffing required to carry out plan
- Discuss FRA Rules and Regulations or any other Federal Regulations that apply to the system
- Discuss operating plan for special events
- Describe system security plan, including staffing requirements. Indicate whether security services will be contracted to a service provider or provided by existing municipal security forces
- Describe parking plans for both opening day and design year

In the early PD phase, it is not atypical for a Project Sponsor to lack a sophisticated simulation model to evaluate the proposed project, which may, in turn, cause it to under- or over-state the capacity of the proposed project to meet ridership demands and power requirements and possibly lead to an ineffective and inefficient layout of critical elements of the project's physical plant and equipment. FTA has assisted in financing studies done under the Transit Cooperative Research Program (TCRP) that address transit capacity analyses. In particular, the TCRP Report 100 (second edition), entitled Transit Capacity and Quality of Service Manual [Ref. 3-18] is a good reference for a Project Sponsor to provide such an analysis for its proposed project. Before FTA approves entry into the Engineering Phase, it may charge its PMOC with the task of performing a Transit Capacity Analysis to determine the suitability and project budget conformity evidenced in the proposed scope of the project as the Project Sponsor defines it.

3.3.2.1 *Operation and Maintenance Costs (O&M Costs)*

Transit system O&M expenses often increase after a transit project goes into revenue service; this typically requires additional subsidies to continue operating and maintaining the transit system. FTA is obligated to determine whether the Project Sponsor has the financial capacity to fund these additional expenses without reducing existing service levels, deferring maintenance, or otherwise causing significant adverse impacts to current service. Consequently, the operating plan must clearly identify how existing operations will be affected by the proposed project. For example, fixed guideway projects often result in significant service realignments. The operating plan should provide details on:

- How the project will impact existing operations, revenues, and O&M costs
- How bus routes will be realigned
- What bus routes will be dropped
- What new feeder routes are planned

The operating plan must contain at least five years of historical and 20-year forecasts of O&M expenses for the existing transit system and for the proposed project. The O&M expenses must be supported by information regarding service characteristics of the Project Sponsor such as revenue fleet composition and assignment, projected vehicle revenue miles, vehicles in service, directional route miles, and number of stations and other system facilities.

Changes in O&M costs have three components: (1) inflation for labor and materials, (2) service/operating changes, and (3) changes in productivity. The plan should include inflation assumptions, the planned system-wide operating and service characteristics, and productivity assumptions. The accompanying text must document the O&M cost estimation methodology, preferably resource cost build-up, and must describe the service plans for the proposed project and existing transit system. The cost estimation documentation should provide details regarding operating labor, maintenance labor, security labor, fuel, supplies, administration, and other relevant cost categories used to calculate annual O&M costs. The output of this plan is an estimate of operating statistics that include vehicle-miles, vehicle-hours, peak vehicles, etc., which become inputs used to calculate O&M costs.

With respect to service changes, there are two types of O&M costs – fixed costs and variable costs relative to service level. Fixed costs, such as station lighting, remain constant and are based on the physical facilities of the fixed guideway system, regardless of the service level. A variable cost item is an item of expense that is linked to the service characteristic to which it is most closely tied, such as traction power for an electrified system. A standard system of accounts should be used for the cost model consistent with FTA National Transit Database (NTD) requirements.

☞ More information on O&M costs is available at the NTD website. [Ref. 3-19]

During project planning, a unit of the transit system facility, such as length of guideway or number of stations, could be considered a variable with associated maintenance cost per unit. Once the guideway length and number of stations become known, the fixed maintenance costs, which are unrelated to service level, can be calculated. An example of a variable cost related to service level would be vehicle maintenance related to the number of miles traveled or number of hours in service. Other vehicle costs such as inspections, which are performed periodically regardless of the number of miles traveled, are considered to be fixed costs. Some modernization projects may reduce O&M costs that can be used to justify the capital investment. Others, such as adding vehicle air conditioning, can increase O&M costs due to increased electrical consumption and maintenance requirements. General guidance on estimating O&M costs is contained in:

☞ Estimation of Operating and Maintenance Costs for Transit Systems [Ref. 3-20]

Where outside contractors are employed to operate, maintain, and/or finance a project, the fundamentals of such contracting must be incorporated within the analysis of O&M costs for the new project as well as the balance of operations, facilities, and services.

3.3.2.2 *Operating/Maintenance Funding Considerations*

The operating plan is required to demonstrate the ability of the Project Sponsor to rely on non-Federal funding sources to operate and maintain the entire transit system after the proposed project is in revenue service. The operation and maintenance of the proposed project is likely to place additional burdens on the Project Sponsor's local funding sources. Transit agencies usually need to acquire new revenue sources or have existing sources that provide sufficient extra operating revenues to fund the proposed project's operation and maintenance.

The operating plan should incorporate fare revenue forecasts for the proposed project and the existing transit system. Fare revenue forecasts are of necessity based on ridership forecasts and assumptions regarding fare levels. The plan also should provide historical revenue figures and forecasts for all other operating revenue sources and the assumptions used to develop the revenue forecasts. Other sources of revenue typically involve advertising, leases, and concessions, including parking lot fees. Inflation assumptions are critical to revenue forecasts and must be explicitly documented in the financial plan. Often, a source such as a local sales tax that is to be used for local capital funding may also be used for O&M expenses. The plan must include documentation proving that the proposed operating funds are committed to their intended purpose.

3.3.3 Cash Flow Analysis

The overall objective of the Project Sponsor financial plan is to demonstrate that the Project Sponsor has the financial resources to successfully construct the proposed project while adequately operating and maintaining the existing and planned transit system. For this reason, the cash flow statement should combine the results of the capital plan and the operating plan to summarize the year-by-year financial condition of the Project Sponsor throughout the 20-year analysis period. The goal of the cash flow analysis is to demonstrate that the Project Sponsor can meet its capital, operating, and maintenance commitments each year, which includes providing an allowance for contingencies.

Cash flow analysis is a valuable tool for project planning. Its application permits Project Sponsors to develop and test strategic funding scenarios, examine alternative assumptions, and conduct risk analyses as part of the Project Sponsor's continuing financial planning activities. These include assessing the impact of delays in Federal or other financing and the issuance of bond offerings at different times and different amounts. The cash flow statement must include at least five prior years of actual costs and revenues to provide a clear picture of the historical financial position of the Project Sponsor and to substantiate the growth rates assumed in future years.

The cash flow statements must be structured in a way that reflects the Project Sponsor's restrictions on operating and capital funds. Many agencies have restrictions on the use of cash balances such as debt retirement, contractual obligations, lease deposits, uninsured losses, or reserve accounts for specific projects. If a Project Sponsor is subject to any of these restrictions, the cash flow statement must identify balances in these restricted accounts and not include them as "available" cash.

During the construction stage, the cash flow estimates are incorporated into a cash management process, to ensure that adequate funds are actually available to pay for all obligations as they become due.

3.4 Scheduling

3.4.1 Scheduling Principles

A project must be planned before it can be controlled. Techniques of planning and control have improved; today, computer software programs enable the representation of work flow in networks, permit planning of resource use and cash requirements, monitor actual performance, and aid forecasting. While different methods are available, such as the Program Evaluation and Review Technique (PERT), which predominates in research projects, the construction industry relies heavily on the Critical Path Method (CPM).

CPM defines the critical path as the longest path of activities in the scheduling logic measured in time. It follows, consequently, that any critical path activity that is delayed, delays the project completion. Another important scheduling concept is “float”. Activities not on the critical path have “float” or “slack”. Total float is the difference between when an activity *can* start and when it *must* start to avoid project delay. Free float or non-interfering float, if used, will not delay the early start of succeeding activities.

There are a number of powerful, user-friendly commercially off-the-shelf (COTS) scheduling and schedule risk analysis software programs on the market. Most of these programs use the Precedence Diagramming Method (PDM). PDM is represented by activity bars (nodes) with lines representing logic connections.

A CPM network diagram serves as a visual representation of the sequence of activities needed to fulfill project requirements. As such, it should:

- Show graphically, in logical sequence, each of the activities necessary to complete the project or project phase.
- Identify the duration of each activity and identify all predecessor and successor activities.
- Show all interfaces, including interdependencies and relationships with operations of consultants, contractors, and suppliers. The information needed to show the Project Sponsor should furnish these interfaces.

- As an option, identify the resources needed to complete an activity using CPM scheduling. Resources include labor, major equipment, materials, and the funding required to support these resources. Resource utilization is an optional technique used to build and maintain schedules. When done correctly, resource utilization is an excellent and preferred technique to best plan for the allocation of major resources to meet peak demand and evaluate what-if scenarios when time extending problems arise.

Given the above description for each activity to be scheduled, a CPM network diagram will provide the following information for each activity:

- Critical Path
- Activity ID and description
- Original Duration, Percent Complete, and Remaining Duration
- Early start and late start dates
- Early finish and late finish dates
- Total float

3.4.2 Scheduling Process

During the project life cycle, the Project Sponsor will manage several types of schedules developed and maintained by various departments and entities. Each schedule is an integral component of the overall Master Program Schedule or Integrated Master Program Schedule (IMPS). In this instance, “program” refers to a portfolio of multiple projects.

Schedules are one of the management tools that project managers at all levels use to maintain accountability for activities taking place. In addition, schedules permit managers to anticipate upcoming activities, to review progress (i.e., planned vs. actual accomplishment), and to modify work plans, as necessary, to meet essential milestones. The following lists includes the most common types of schedules used on a typical transit project:

(1) Master Program Schedule or Integrated Master Program Schedule – A high-level summary schedule containing information from all other project schedules currently developed and maintained on the program. This schedule comprehensively includes all project life cycle phases and is managed by the Project Sponsor or its representative consultant/agency.

(2) ROW Schedule – Developed specifically to address Real Estate acquisition of partial and full takes, easements, potential condemnation process, etc.

(3) Design Consultant Schedule or GEC Schedule – A schedule specific to engineering design for one or more design contracts. Typically a contractual requirement between the Project Sponsor and the engineering design firm.

(4) Proposed Construction Schedule – A proposed construction schedule usually developed by a GEC, Project Manager or CM with input from the Project Sponsor. Proposed construction schedules may include one or

more construction contracts according to contract delivery methods and packaging.

(5) Vendor/Supplier Schedule – Schedules developed and maintained by major vendors or suppliers for rolling stock, Fare Collection equipment, substations, etc.

(6) Construction Schedule – A construction contractor schedule in accordance with the CPM Schedule specification requirements. The Project Sponsor or its representative must perform compliance review of every contractor schedule submission and ensure all vendor, design and construction contractor schedules are coordinated in accordance to the IMPS Plan.

(7) Commissioning Schedule – Usually required for the commissioning of facility buildings, control centers, vehicle maintenance facilities, etc.

(8) Start-up and Testing Schedule – Developed and maintained by the Project Sponsor, system integration consultant or contractor. This schedule is highly recommended for all projects and especially needed for minimal operable segment revenue operations, "soft openings" of revenue operations, and coordination with third-party operators and intermodal center adjacencies.

(9) Time Impact Analysis Schedule – Usually prepared by a construction contractor seeking equitable adjustment for compensable damages and or requesting excusable delay warranting a time extension. A Time Impact Analysis can also be performed by the Project Sponsor or its representative to counter a contractor claim.

(10) Schedule of Record – Sometimes referred to as an "As-Built" schedule simply documenting the actual dates and sequence of events specific to the contract (design, vendor or construction).

The Project Sponsor will receive and manage most all of these schedules as the various consultants, vendors and contractors engage the program. Inherently, each of these schedules will ultimately be summarized into the IMPS and managed by the Project Sponsor. In order to facilitate this process, all schedules and scheduling parties must conform to a standard set of Schedule Management Standards.

Before the Project Sponsor begins scheduling, it must develop scheduling standards that are robust and flexible enough to allow for multiple scheduling parties and expansion and contraction of program scope. The standards should address at least the following topics:

(1) Project Sponsor Project Control Organization
(2) Schedule Type Definitions
(3) Anticipated Scheduling Parties
(4) CPM Schedule Specifications
(5) Schedule Development Procedures
    a. Basis of Schedule Narrative
    b. Schedule Software (requirements and training)
    c. Software Settings
    d. File Naming conventions
    e. Calendar Library

f. WBS
g. Activity Coding and Custom User Defined Fields (UDF)
h. Resource Library
i. Cost Resource standards (Cost Breakdown Structure if used)
j. Report layouts and formats

(6) Schedule Update Process
k. Submittal Package
l. Submittal Process (Review and Approval)
m. Work Progress Measurement

(7) Claims: Time Impact Analysis Process
(8) Reports (Custom per reporting audience)

Best Practices and avoiding common mistakes

The following list includes best practices used to prevent schedule management and program control mistakes:

(1) Develop a clear Project Sponsor Organizational Breakdown Structure (OBS) and orchestrate it with a staffing plan to ensure technical capacity and capability necessary to develop and implement a Project Management Control System. More and more Project Sponsors are using "blended" organizations consisting of partnering agencies and consultants. Key level management positions must be carefully evaluated to determine which agency or consultant team is best capable of filling the position.
(2) Develop WBS, OBS and a Responsibility Assignment Matrix (RAM) to clearly identify the position descriptions, roles and responsibilities all of departments, individuals and entities on the program.
(3) Establish Schedule Management Standards before or during the PE phase.
(4) Use project control tools to assist with the evaluation and analysis of determining project delivery methods.
(5) Use Schedule Risk Analysis tools (Monte Carlo/Latin Hypercube) during the design phase when developing proposed construction schedules and contract time determinations for each contract (design, procurement or construction).
(6) Synchronize the project budget cost estimate and IMPS when revisions to either document are made.
(7) Develop ROW schedules in sufficient detail and integrate them properly with the contract packaging plan, engineering design efforts, permitting, and utility coordination efforts.
(8) Use CPM Schedule Specifications that are comprehensive, well communicated and well understood by all parties.
(9) Enforce construction contractor schedule conformance strongly and properly. Baseline CPM Schedules should be reviewed and approved prior to construction NTP.
(10) Use progress update reporting to comprehensively decipher, properly analyze, and summarize data in order for management to make decisions and corrective course of actions.

Procedures for schedule control must be included in the PMP. Following are five elements that make up schedule control:

- *Schedule Baseline or Baseline Integrated Project Master Schedule* – Establish a project schedule that includes all of the activities that must be performed to complete the project, duration of the activities, and resources required to accomplish those activities.
- *Monitoring/reporting system* – Regular task status reporting by WBS element is required. Include activity commencement and completion and accomplishment of other milestones and monitored them in the schedule baseline. At a minimum, monthly progress reports should be required in contracts.
- *Performance measurement system* – Using the data from the monitoring/ reporting system provide a means to compare actual work performed to the scheduled work and analyze any variances that may occur. This comparison should result in the submission of timely status reports to responsible managers.
- *Schedule forecast* – Provide a system for routinely forecasting the expected schedule for completion of work packages and the total project.
- *Schedule review and update* – Make work package schedule forecasts available to the immediately responsible managers. Perform a continuous review of progress against the schedule so that resource reallocation or other corrective action can be undertaken as early as possible. Schedule changes that impact on other work packages should result in timely alerts to higher level managers. Project managers should perform reviews of the project schedule on a regular basis to identify developing trends and to point out potentially significant problems in the schedule forecast. Schedule updates should only be made by the person specifically assigned that authority. The official project schedule at any point in time is known as the Integrated Master Project Schedule, or IMPS.

3.4.3 Integrated Master Project Schedule

The Project Sponsor must be able to manage and control the Integrated Master Project Schedule (IMPS). This schedule should be developed in the early planning stages of the project and should include all project phases, culminating in project closeout activities subsequent to revenue operations. The Project Sponsor should refine detailed schedules for each phase and significant activity (e.g., NEPA requirements, FTA reviews and anticipated actions, the entire Real Estate program, permitting or other approvals by third parties, etc.) therein as the project progresses, thus integrating these to produce a true Integrated Master Project Schedule. As these lower tier or major phase activity schedules are integrated, they may show where the IMPS will require changes to eliminate inconsistencies and meet the external schedule requirements. The detailed schedules -- in showing all significant project activities, especially all that could affect the critical path, including permitting, real estate acquisition, bidding and procurement, system integration, testing, and start-up -- will roll-up into the IMPS.

An initial baseline IMPS should be developed during PD Phase and refined during the Engineering phase such that it accurately depicts a logical project implementation process that will require minimal revision as the project progresses. To develop a reasonably accurate IMPS, experienced engineering design, project control, and construction management personnel should determine the time requirements of the activities within each work package to implement the scope of work. The design activities scheduled must be closely monitored and updates incorporated into the IMPS.

Considerable experience may be required to understand the complexities of the work, particularly where underground construction is occurring, where there is a need to maintain transit service during construction activity, or where there are numerous contractor interfaces. In addition, expertise from those responsible for Real Estate and permitting should be used to determine realistic schedules for real estate acquisition and permitting time. Finally, the expertise of those responsible for the project budget (as “time is money” and schedule constraints impact likely bid considerations by contractors) should determine budgeting issues that might impact the IMPS planning and analysis, such as contractor allowances, overhead costs, and the cash flow implications to the Project Sponsor.

3.4.4 The Construction and/or Procurement Schedule(s)

Most large transit construction projects require contractors to provide detailed schedules for their work to the project’s controls group in a format compatible with the scheduling software used by that group. The information needed to evaluate progress, including labor loading charts and equipment schedules, should be specified in project directives and contract bid documents. Project organizations should submit a schedule update and supporting data to the control office monthly. The updated network diagram should be prepared in accordance with the following:

- All activities should be updated and reported on as of the same date.
- The updated logic schedule report should discuss completed activities, any revision of the logical sequence of the activities, and the critical path of activities based on the current update.
- The supporting data for the updated schedule should include a listing of the actual starting dates for each activity in progress and actual starting and completion dates for all completed activities. In addition, an analysis of changes to expected completion dates should be included that identifies which activities contributed to the changed completion date and why.
- The supporting data also should contain all information needed to indicate the current status of the project, such as design policy memoranda or other technical data issued by the Project Sponsor or its representative, design/development progress in prime contracts and specialty procurement contracts which necessitates revision to current contracts, changes required by utility companies or local agencies during the course of construction, finalization or revision of agreements between the Project Sponsor and public agencies, revisions to ROW agreements, and revisions necessary to accommodate changed or unforeseen field conditions or changes at interfaces of adjacent contracts.

FTA provides guidelines for coordinating and monitoring contractor schedules that should be incorporated into contract specifications:

☞ Review of Project Management Control Systems on Selected FTA Funded Projects [Ref. 3-21].

- Schedule control during the Procurement and Construction phases is generally the most difficult. This is because there are usually several contractors performing work on different elements of the project, often with overlapping work areas involving different trades. Controlling or monitoring the schedule performance of more than one contractor involves more effort than monitoring the status of a single design consultant's work.

- Contractor schedules should be compatible with the scheduling software utilized by the Project Sponsor. Contractors should be required to submit copies of the schedule in electronic format. Ease of integration is important to maintaining the Project Master Schedule with current contractor schedule data. All contractor updates should be integrated and checked for impacts to other project elements within the Project Master Schedule. When contractors submit monthly CPM updates, all milestone dates should be checked to determine that they are within the contract parameters and whether the dates scheduled are attainable based on the contract status.

- Schedules are generally submitted in more than one part. One part consists of a schedule indicating the work to be performed during the first 60 to 90 days of the contract. This submittal is usually required to be presented within two weeks of notice-to-proceed.

- Between 45 and 60 days, an additional schedule submittal is made that encompasses the full contract duration and includes a breakdown of all activities to a level of detail specified in the contract documents. Updates and narrative reports concerning the updates and schedule status are usually required on a monthly basis.

- Receiving the initial CPM submittals and updates in a timely manner is important to the development and maintenance of the IMPS. Enforcement provisions within the contract scheduling specifications help agencies ensure the information flow necessary to keep the IMPS current, making them a useful tool for managing the project. The most common enforcement provision gives Project Sponsors the option to withhold progress payments pending submittal of acceptable CPM schedules and updates in accordance with the contract. Progress payments are generally based on updates of the contractor's cost loaded CPM schedule. Without an acceptable schedule status update, progress payments should not be made. An alternative schedule submittal enforcement provision is model that requires a separate bid item with specified minimum bid amounts for schedule submittal. Portions of this bid item are withheld and forfeited for untimely or missing schedule submittals.

- The WBS on which the bid and contract's schedule is based should be adequate for the project. The optimum level of detail is dependent upon the complexity and needs of a particular project. Cost loading of the contractor's CPM schedule should be tied to the bid breakdown, which is generally tied to the WBS.
- Requiring cost loaded CPM schedules provides an increased ability to monitor the status of a contract, specifically the progression of the work and the corresponding expenditures. Also, the completion date for the contract and cost to complete can be monitored. The larger the contract, the more useful and practical the process and the greater the benefits derived. For a smaller project, the required cost-loaded schedule could be difficult to prepare, maintain, and administer due to the need for full-time experts in scheduling personnel on both the contractor and construction management staff.

- Project Sponsors may prefer to award contracts on a lump sum or unit price basis. Cost loading a lump sum contract CPM requires allocating percentages of the various bid line items to particular activities. Monitoring and updating is based on incremental percentages of each item that make up the lump sum bid price. To facilitate progress payments, it is helpful to require that activities be 100 percent completed before being eligible for the release of payment. This effectively of shortens the contractor's activity durations to promote payments that closely match the work in place. Verification of 100 percent completion of activities is also easier than estimating or measuring incremental portions thereof.

- On unit price contracts, the activities are tied to costs associated with unit price quantities. Quantity overruns and underruns must be monitored so that accurate indications of the project’s status are maintained.

- CPM scheduling enables the Project Sponsor to maintain its IMPS. Each IMPS has a critical path of its own that must be closely monitored to complete the project within the established time constraints. Each IMPS has a critical path that may traverse activities on several individual contracts throughout the total project duration. The Project Sponsor's designation or recognition of critical project elements is important in the project control process.

- Where elements of a particular WBS within individual contracts or contract completion dates are crucial to the execution of a project, contract milestones must be established and incorporated into the contract documents. These include milestones required for the work by other follow-on contracts to proceed. These crucial milestones normally become the basis for the critical path of the individual contracts. A major benefit of contractor CPM schedule requirements is the ability of the Project Sponsor to monitor the progress of the contractor on the critical path. Progress on the critical path means progress toward contract milestone or completion dates that may impact the project’s completion if not successfully met.

- Being able to integrate the individual contractor's schedule into the Project IMPS benefits the Project Sponsor, who should require that the software utilized by the contractor in developing its CPM schedule is compatible with the Project Sponsor's. The Project Sponsor should also require contractors to provide electronic copies of all schedule submittals to facilitate integrating the contractors' CPM schedule submittals and updates into the IMPS.
- Monitoring the contractor's CPM schedule includes monitoring its critical path. Where critical path activities fall behind by a specified number of calendar days of meeting a milestone or the contract completion date, a recovery schedule should be required for the contractor to establish a plan for accelerating or adjusting its schedule in order to meet the specified milestone or contract completion date.

Earned Value/Progress Measurement, Integrated Cost, and Schedule Control

The Earned Value (EV) concept, first developed in the aerospace industry, has proven effective on other types of engineering projects across the nation. It provides the capability for the routine and in-depth analysis of project status from an integrated cost/schedule perspective. The implementation of the EV concept is one means to improve management of the project by allowing use of more effective project control information.

- All milestones or contract completion dates critical to the project completion should have commensurate penalties (liquidated damages) established for failure to meet the contractually mandated schedule. To truly enforce liquidated damages, there should be a bonus clause for early completion of commensurate value.

3.5 Controlling the Project

3.5.1 FTA Requirements

As part of the Federal grant making process, FTA places explicit requirements on Project Sponsors regarding their control of the major transit projects that it funds. These requirements can be satisfied by developing effective PMPs with sound implementation, as discussed throughout this document. Elements of sound control systems are described in the following sections, and are organized around the concept of a WBS, discussed earlier in this chapter.

3.5.2 Integrating Time and Cost

The fundamental concept of controlling time and cost establishes a baseline and compares progress update information against the baseline. Metrics must first be established in order to define how actual work is measured and compared to the baseline -- the most traditional method uses earned value.

The most critical element in this process is understanding how and when to establish a baseline (schedule and budget). It is never too early to establish a baseline -- without it, progress updates and variance analysis cannot be performed to support management decision making and corrective courses of action.

Baseline scope, schedule and budgets can be revised at any given point in the project life cycle phase. Such revisions do need to be clearly documented as part of the configuration management process in order to document an accurate baseline revision history. A schedule baseline cannot be established without a budget baseline, and vice versa, as the two are interdependent.

In order to adequately perform progress status measurement and control, the program WBS must be established and incorporated into all baseline documents. Depending on the detail of the WBS, a Cost Breakdown Structure (CBS) may be needed to support the schedule and budget earned value and cost forecasting reporting. The CBS is typically a more detailed WBS that contains a cost account classification necessary to support the Project Sponsor financial management system, consultant and contractor progress payments, FTA record keeping requirements, and the means for maintaining a valuable historical record. A combination of the WBS or CBS also supports budget and schedule fund management, cash flow reporting, and commitment curve projections.

Project costs and the project schedule are integrated at a high level in the Cash Flow Analysis. This integration strengthens as more definitive information becomes available during the evolution and refinement of the project life cycle.

For example, during the PD Phase, a fixed guideway project, the costs of the guideway may be evenly allocated over the anticipated construction period. As part of the development of the schedule and the construction contracts, the anticipated costs of each contract must be allocated in accordance with the proposed schedule and compared with the anticipated revenue stream. If funds are inadequate during any period, either the proposed schedule must be revised or steps must be taken to adjust the revenue stream (e.g., issuing of RANS, GANs, or bonds as noted earlier). A similar review should be conducted as bids on the contracts are received and before the contracts are executed.

The appropriate methodology for assuring the proper integration of schedule and cost is to relate cost control monitoring activities to the WBS-derived work packages. Responsibility for developing baseline cost budgets should be assigned to managers of work packages to maintain those baselines consistent with the WBS, schedule WBS, and overall costs. Authority to revise the baselines should be assigned and coordinated with the configuration management plan. The work packages should be identified using a coding system compatible with the project accounting system to facilitate establishing a computerized cost tracking and reporting system.

Special attention must be paid when Force Account activities (or support activities) are on the critical path, since managing these activities is generally separate from managing contractor activities. Separate management may result in separate priorities, which could, in turn, result in the scheduling or diversion of the Force Account manpower to perform maintenance tasks, thereby delaying critical path activities. Such delays could result in exposure to claims for adjustments by private contractors as well as delays in the total project. The scheduling of Force Account activities should, therefore, be integrated into the total project schedule.

3.5.3 Controlling Costs

Proper cost estimating is key to controlling costs. When the National Research Council was asked to study the causes of increases in costs in construction projects, the Subcommittee on Management of Major Underground Construction Projects (Committee on Tunneling Technology) included in its recommendations the following:

> *Realistic cost estimates, based on the best available information, must be used from project inception. Recognizing that early estimates are based on many uncertainties and variables, and therefore that costs may be overlooked or underestimated, realistic factors for uncertainties and contingencies should be taken into account during early phases. Particular attention must be given to realistic estimating during the preliminary engineering because such estimates are usually the basis for project financing. Estimates need to be revised periodically to accommodate changing circumstances* [Ref. 3-22].

The FTA Capital Cost Database can be used as a reference guide for historical cost data on FTA funded projects. The following principles of cost control and features of a formally approved cost control program should be considered and incorporated as part of the project capital plan (Section 3.3.1.1):

- Because the baselines for cost control are projections, allowances for inflation must be included. Inflation allowances should be defined and applied to specific cost categories (construction labor, materials, services, etc.).

- A contingency fund should be established, which may include additional inflation allowances. A system should exist for determining and distributing the contingency funds to provide for cost escalation caused by unanticipated inflation or such factors as changed site conditions, design revision, and estimating uncertainties. The contingency allowances can be held at the project level or, especially in larger projects, can be distributed to lower levels of management in the WBS. Strict controls should be established over the disposition of funds from these accounts. Further, the cost control program must include an unallocated contingency at the project level to reflect a careful risk analysis. The unallocated contingency must be sufficient to address and overcome increases in cost that are due to potential risks (uncertainties), and for which no other mitigation (primary or secondary) measure is available. Taken together, allocated and unallocated contingency provide what FTA refers to as total contingency in MCPs.

- All budget transfers should be documented. If a line item is projected to underrun its budget, funds should be moved into the contingency account even if they are reallocated to another line item. All funding increases to line items should come from the contingency category to better facilitate tracking costs in the future.

- The participation of a cost engineer(s) throughout the life of the project is prudent.

- A program must be established for cost risk identification and management. For MCPs, a Cost Management Plan has to be developed by Project Sponsors, as well as a Risk and Contingency Management Plan (RCMP).

- Care should be taken in estimating the costs for ROW and real estate acquisition programs, construction management, and administration. A study of five recently completed rail transit projects found that at least three of the five projects experienced more than 20 percent cost growth in these categories, in comparison to the estimates made during design. However, in some cases, increases in these costs led to overall project savings. In three cases, major changes in alignments impacted design and ROW acquisition programs (two were impacted negatively and one positively). Reorganizations in two cases had major positive impacts on project control. In one case, a major design change had a significant positive impact on project cost [Ref. 3-23].
- Depending on the item or service being procured and the applicable conditions, care should be exercised in selecting the proper contract type (firm fixed price, unit price, cost plus fixed fee, various incentive fee arrangements, etc.) to ensure cost-effectiveness. Selection of contract types to support alternative project delivery methods also can be considered.

- Contract package size and scope should be selected with proper regard for the management and financial resources available to the Project Sponsor to obtain the greatest efficiency and economy in using the resources. More contractor interfaces mean a more complex and difficult to manage project.

- A system should be established and responsibility assigned for predicting cash flow requirements and for providing for timely receipts and payments.

- Strict control of project expenditures is an inherent obligation of the project management team. The team must have adequate delegated authority and flexibility in the management of expenditures and the determination to use and control them. Authorization should be documented for capital expenditures, for issuance of work orders, and for additional work orders. Procedures should be established for verification of requested payments and processing of partial payments and final payments.

- Procedures should be developed and responsibility assigned for identifying, evaluating, and accommodating changes that may occur during design and construction, steps generally assigned to configuration management.

- Project management must adopt cost/schedule/progress monitoring and financial reporting systems with sufficient detail to enable key managers to make timely decisions. Senior managers should participate in developing the reporting system to ensure that it meets their needs. The monitoring system should identify problems or necessary actions before they become critical (or historical) so that problems may be avoided or actions taken in proper time.

More on the FTA requirements for MCPs relative to risks and contingencies may be found in the risk assessment and management discussion later in this chapter.

3.5.4 Controlling Project Configuration and Changes

Throughout all phases of the project, there must be consistency in how various physical and technical aspects are defined and recorded. Descriptions of both physical and technical aspects are used to articulate the project definition. During both design and construction, this project definition is used to ensure that its original concept is followed and that the completed system will function as designed.

Configuration management consists of the evaluation, coordination, and approval or disapproval of changes in the configuration of a component, system, or process after its baseline has been defined. The project is typically baselined at the completion of the PD Phase to allow accurate and comprehensive monitoring of any changes that follow and to establish the basis on which the project cost estimate is determined. In the case of MCPs, the baseline for the project definition will be established during the initial Engineering Phase activities but prior to FTA considering an FFGA, as it is those details (in drawings, specifications, contract packaging and scheduling) that must be carried forward and be implemented. A similar approach is taken by FTA with regard to PCGAs for non-MCP projects.

In an effective configuration management program, drawings are uniquely numbered and otherwise identified. Specifications follow a standard format and each section, subsection and paragraph is identified. Complete drawing lists are established and the total number of drawings, the titles of the drawings, the revision status, and the dates on which the drawings were approved are recorded. Procedures are established and changes to approved drawings or specifications should only be made in accordance with these approved procedures. Permanent files are maintained of all contract documents that include historical information relating to all project changes. As the project is implemented, configuration management evolves to include the documentation of the completed improvement in terms of "as-built drawings."

Configuration management ensures that the correct, approved status of the evolving design is known or is available to all project personnel using that information. When done properly, configuration management ensures that replacement equipment or components capable of meeting the original equipment requirements can be procured at a later date.

Brief definitions of the physical and technical components of a project definition follow:

- *Physical* - Describes the total system in sufficient detail to permit preliminary design concepts to be prepared. This includes location descriptions, trackage layouts, facilities, interfaces with existing systems, proposed passenger vehicle configuration, above and below ground segments, landscaping, crossings, overpasses, and any other physical definitions of the system which will provide a full appreciation of the system's overall suggested characteristics.
- *Technical* - Defines the interrelationships and functions of the system in sufficient detail to guide construction. This includes design/construction considerations and techniques, systems, connections/interfaces with existing systems and utilities, maintainability of the fixed facilities, system operations and characteristics, and any other data that explains or details system operations/performance.

A project's definition must evolve in an orderly manner throughout the project development process. To arrive at the definition, design criteria and the desired performance characteristics of the completed project must be developed early in the project. Design/performance criteria should exist for the following elements:

- *System-wide* - capacity, safety, security, emergency procedures, system dependability, vehicle availability, ride quality, accessibility, comfort, convenience, aesthetics, environmental, etc.
- *Subsystem* - vehicles, control, communications, power distribution, Fare Collection, support equipment, etc.
- *Fixed Facilities* - guideway, stations, station amenities, access/egress, parking, intermodal features, central control facility, maintenance and storage facilities, administration facilities, etc.

Once the project definition is established during design, it becomes the standard for accomplishing construction; more importantly it is the "blueprint" for describing how the system will look and function. The project's physical configuration provides specification detail for the project definition. The configuration baseline includes the drawings, lists, calculations, specifications, and reference documents that completely describe the project. Among the most important management considerations relating to the system configuration and performance are the following:

- *Design Documentation* - Once design criteria have been established, standards should be developed in each area. Each design task within an organization's area of responsibility should be scoped, planned, and scheduled in the same manner. Task statements that include requirements, assumptions, and a detailed list of deliverables should be prepared and identified using a definitive Work Order Breakdown (WBS) structure. The design tasks should result in the preparation of drawings and/or specifications, calculations and analysis reports (or technical memoranda) for all items and systems.

- *Interface Definition* - A critical activity in the system definition process is the identification and documentation of system interfaces which may place constraints on its design or performance (e.g., power supplies, other utility and service interfaces, physical constraints). The preparation of interface drawings, calculations, specifications and analysis reports (or technical memoranda should be undertaken during the design process.

- *Reliability and Maintainability* - Evaluating system and equipment reliability and maintainability; developing System Reliability Plans and System Maintainability Plans, and carrying out Reliability and Maintainability Program activities have a significant impact on a system's configuration, detail design, and operation.

- *Peer Review* - A structured, independent review of an organization or project by a team of experts. Such reviews cover all design phases and categories, including organizational, project management, and aspects of project design and functionality, construction, operations, or maintenance. Typically, they are organized and conducted to focus on special topics or situations with a specified purpose, scope, format, and duration.

- *Value Engineering (VE)* - VE is a formal, systematic, investigative technique with potential for reducing both capital and O&M costs of major transit projects. VE reviews a product, system, or facility in order to identify and analyze the functions it has been designed to perform. A project's total life cycle costs (costs incurred by constructing and utilizing the product as designed) are calculated, and alternative designs are generated to determine the most cost effective method of performing the identified functions, consistent with requirements for quality, reliability, maintainability, and safety. A VE study is a creative, multi-disciplined team effort that FTA requires at the end of PD. In some instances, it may be beneficial to repeat the VE during Engineering or even during project construction. A consultant with experience in conducting VE studies for transit projects may be used to manage the study, although a qualified team of professionals could also be selected to participate. Participants are most effective if they have not been significantly involved in the design being studied. The Society of American Value Engineers (SAVE) provides certified training for VE. See Sections 4.7.6 and 5.2.7 for additional guidance on VE.

- *Operation and Maintenance (O&M) Interface* - It is important to address O&M concerns in design and construction, particularly during the design phase. A continuous review by the owner, consultants, and O&M personnel ensures that the final design incorporates those features that are consistent with projected O&M needs and costs. Early development of system operating plans and their corresponding projection of operating statistics, operating costs, and operating revenues are essential elements in selection and design of the system configuration. The Project Sponsor should develop a System Operating Plan and a System Maintenance Plan and evaluate the evolving design with respect to them. Consideration should be given to life-cycle costs and issues such as system continuity, safety, security, and reliability in relation to budgeted construction costs.

- *Constructability Reviews* - "Constructability is the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives." [Ref. 3-24]. Before completion of PD and continuing through Engineering, it is important to review the constructability of the proposed project to avoid subsequent adverse cost and schedule impact. Constructability should be considered in the development of a contracting method and in the development of overall project schedules. Basic design approaches must consider major construction methods. Site layouts should promote efficient construction as well as efficient operation and maintenance. Prior to final approval, a constructability review of the planned construction contract should be performed. These reviews should be included as part of more general design reviews as noted above.

- *Design Reviews* (in addition to QA/QC practices) - To ensure that project objectives are being met, design reviews by the owner, consultants, and operational staff are held to focus on consistency with design criteria, possible errors and omissions, and constructability. The extent of the review(s) should be based on consideration of the consequences of failure, the Project Sponsor's experience with the design organization's in-house checking capability, and aspects of the QA program. Just as with QC procedures, it is essential that design review comments are documented, tracked and that formalized closure is brought to all issues in a timely manner.

- *Test Program* - Performance requirements should be translated into test requirements and then into specific test and inspection plans. Policy should be established for acceptance testing of materials, components, and systems. Specific responsibilities should be assigned for preparation of individual unit or equipment test and inspection plans, conduct of the tests, and approval of the results. When applicable, an overall system operational test plan should be prepared. To the greatest extent possible, all aspects of system operation, which determine whether the system performance is satisfactory, should be tested prior to acceptance.

- *Contract Documentation* - Design requirements must be reflected in the items constructed or purchased. As a result, Project Sponsors or their representatives should prepare detailed specifications for procurement and conduct a thorough technical review of the final procurement documentation (Requests for Proposals as well as proposed contracts in final negotiation). In some instances, it may be prudent to pre-qualify contractors to ensure capabilities and capacities before accepting bidders; this would become a two-step bidding process (see Section 2.2.6). Evaluation of bids should verify that the requirements are being properly addressed by the proposed contractors.

- *Training* - In its initial operational stages, system performance is influenced by the familiarity of personnel with the system. The more a new system differs from existing systems in operational and maintenance procedures, the more important it is to address expected manpower needs and training programs. For larger projects, the use of training mock-ups or simulators and tabletop or onsite drills should be considered.

Procedures should be developed for identifying, evaluating, and accommodating changes that may occur during project design and construction. Procedures should: (a) specify clearly who holds the responsibility to initiate and approve changes: (b) permit results to be achieved rapidly; (c) provide for full evaluation of the impact of the changes; and (d) specify how changes will be documented and the records maintained. Project Sponsors are encouraged to establish a Change Control Board (CCB) with charge to attain independent and thorough cost/schedule/functionality reviews and prompt resolution of change issues may help to reduce delays, negative cost impacts and/or claims. *Judicious* delegation of monetary authority to approve change orders at the field level can expedite the change order process. A recent FTA research report found that construction risks could probably be decreased by allowing field personnel to exercise a maximum amount of discretionary judgment regarding change orders [Ref. 3-23].

3.5.5 Risk Assessment and Management

The process of managing risks by Project Sponsors is depicted at Figure 3-5 and can be generalized by the following steps:

- Identify risks inherent to any and all phases and all aspects of the project (inclusive of Project Sponsor and consultant activities from PD through construction)
- Assign risk metric (e.g., cost, time, functionality impact)
- Measure and evaluate risks across all phases of the project
- Analyze risk treatment alternatives, i.e., avoidance, prevention, mitigation/ cost control, and Insurance (purchased or self-insured)
- Select mix of risk control practices and procedures
- Establish metrics and systems to be able to assess performance of project participants depended upon for risk mitigation across all project deliverables (products)
- Monitor and evaluate performance of measures instituted

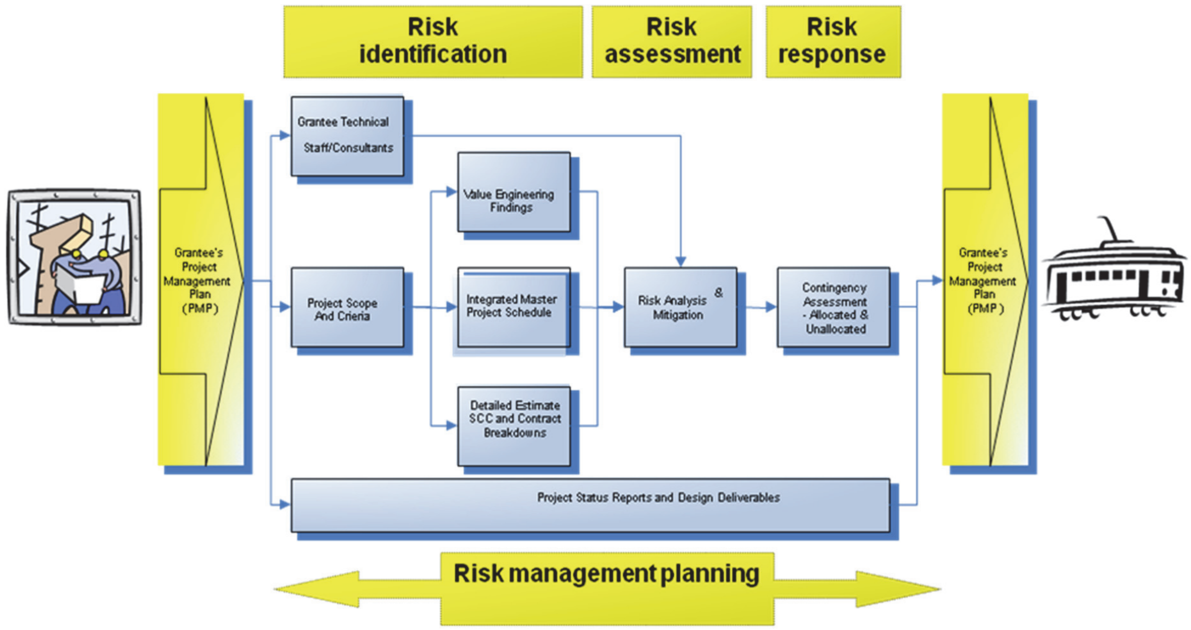


Figure 3-5. Risk Management Process

Potential risks that are identified should be evaluated and available mitigation measures identified. The risk management program should provide for a process in which parameters are rechecked continually. The project overview by the risk managers should be ongoing, multidisciplinary, and include every significant part of the project.

A risk management program should be established for all transit capital projects and is required to be established for all major transit projects. A risk management group from among Project Sponsor management and staff and its consultants should be organized to provide a multi-disciplinary overview of the project and its elements, and to determine how risks affect the technical, legal, political, social, and financial aspects of the project from beginning to end.

A professional risk management program will assist in recognizing the financial and technical uncertainties that may impact a project's budget and schedule. Historically, most large construction projects surveyed have been subject to budget overruns, ranging from 13 percent to 106 percent. Reasons for the overruns include scope changes, optimistic scenarios yielding low estimates of cost and high estimates of benefits, incomplete information about project objectives and features, estimating errors, and delay in construction start dates. Although political and social factors will also affect overruns, the design, construction, and financial risks affecting a project's budget and schedule cannot be overlooked.

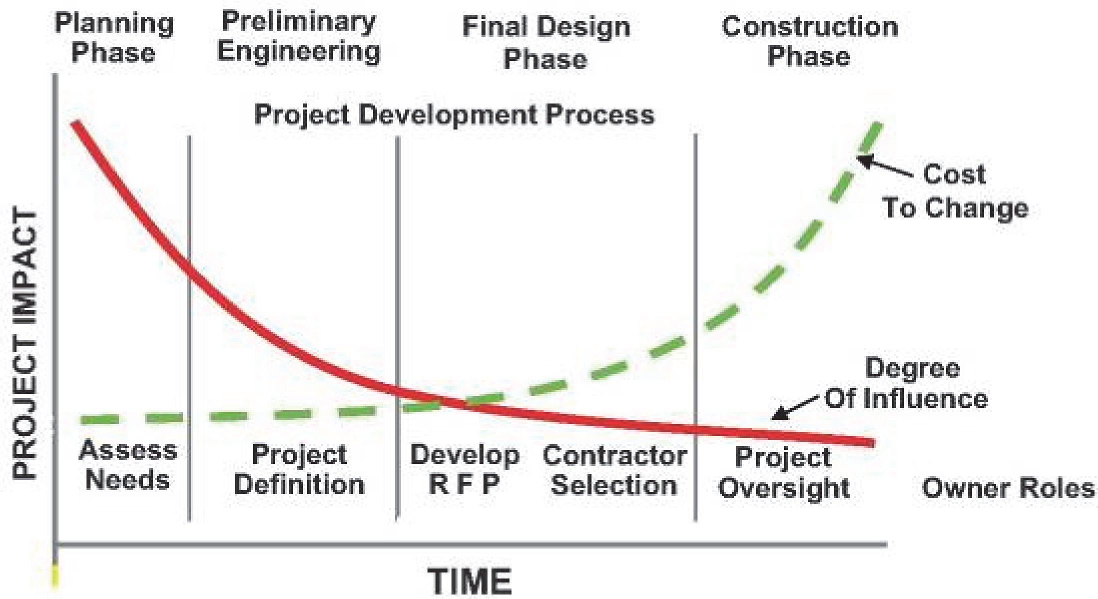


Figure 3-6 Cost Impacts and Mitigation Capability by Phase

With risk-informed, performance-based project management, risk will typically diminish as a project proceeds through the development continuum, from Planning through to RSD, as depicted at Figure 3-6.

The NS project risk review is required concurrent with the Engineering Phase and before the FFGA and SSGA milestones. This risk process also carries forward with updates and analysis during the construction and equipment/materials procurement phase. Appendix E to these ***Guidelines*** contains this Project Sponsor guidance.

3.5.5.1 *Projects Involving Construction of Tunnels*

Risk associated with inadequate geotechnical engineering scope definition during PD and Engineering can lead to significant cost growth from the final design estimate to the contract award amount on transit projects involving underground construction. Within the Project Management Plan (PMP), a Geotechnical Program Plan (GPP) should be developed that functions as a sub-plan for the project and as the parent document to all geotechnical reports.

The PMP should describe the timing and use of the GPP, Geotechnical Data Reports (GDRs), Geotechnical Interpretive Reports (GIRs), the Geotechnical Contracts Risk Allocation Plan, and the Geotechnical Baseline Reports (GBRs). An effective GPP will provide management with the tools to control the process, deliverables, and reviews; provide traceability of the decision making process to allocate or retain geotechnical risk; and will identify the process for establishing the transfer of specific risks and associated financial resources.

FTA's experience with GIRs indicates that they should contain construction considerations sections that address how the subsurface conditions affect alternative approaches to design and construction, how project risks relate to alternative construction approaches, and how construction impacts adjacent facilities and utilities. The project construction project managers and estimators should review these report sections. In addition, the GIRs should be kept current as the project configuration changes. During the Engineering Phase, the GIRs should form the basis for cost estimates and schedules.

The Technical Committee on Geotechnical Reports of the Underground Technology Research Council prepared suggested guidelines titled “Geotechnical Baseline Reports for Construction” and published by the ASCE in 2007 [Ref. 3-25]. This document serves as a reference for preparers and users of GBRs, and to inform owners of the importance of the contents of GBRs as related to the allocation of financial risk. These guidelines provide a checklist of items to be considered when preparing GBRs. This publication also describes the intent and purpose of GDRs, GIRs, and GBRs and distinguishes between each type of report. This document notes that experienced and knowledgeable professionals should prepare the GBR.

The document recommends that the GIR be renamed as a Geotechnical Memorandum for Design (GMD) because that title better portrays its intent and timing within the design process and distinguishes this preliminary interpretive report from the GBR.

The “Geotechnical Baseline Reports for Construction” guidelines recommend that the GDRs and GBRs be incorporated into the construction contract and that the GBR should be given precedence over the GDR within the Contract Document hierarchy. Regarding GMDs/GIRs, interpretations made may conflict or be superseded by subsequent interpretations and baseline statements made in the GBR. As such, it is generally agreed that GMDs/GIRs should not be part of the Contract Documents and the GMDs/GIRs should contain disclaimers to preclude their use for construction. If they are included in the Contract Documents, they should be prepared specifically in conjunction with the design and thoroughly reviewed to verify that there are no inconsistencies between them and the GBR.

3.5.5.2 *Risk Identification*

Risk is defined in different ways by various agencies of the government and across various industries. Essentially, risk can be defined as a reasoned assessment of the potential inability to achieve project objectives within defined cost, schedule institutional and technical constraints. The risks can and should be defined first at the project level and subsequently at the contract level. Identifying and quantifying uncertainties (risks) with their potential impacts on a project’s budget and schedule requires a clear and comprehensive baseline project definition (elements of which are scope, design criteria and quality, cost estimates and schedule). It is crucial for the Project Sponsor in a MCP to ensure the validity and thoroughness of the documentation supporting the baseline project definition. If there are key components missing, costs understated, or the schedule inaccurate/unrealistic then the identification of potential risks could engender untold uncertainties and a higher likelihood that project objectives will not be achieved.

Risk identification plays a significant role in the overall risk management process. Sufficient efforts should be made to ensure that adequate resources and processes are used to develop a thorough listing of risk events, appropriate to the current project phase. This listing provides the basis for development of risk assessment and then risk mitigation action items. For MCPs, the FTA requires Project Sponsors to develop and implement an RCMP that will best ensure that the project team organization has effective procedures in place to identify and ultimately deal with project risks.

Risk can be characterized as belonging to any of the following categories, which are listed in chronological order. Generally, risk is categorized as associated with the category during which the risk may be identified the earliest and have the best opportunity to be mitigated. The categories are listed below. If a risk event is not disposed of during a particular phase, it may survive into the following phase.

- **Requirements Risk** relates to the establishment and variability of fundamental goals and conditions of a project to which the design must respond, as well as the activities of the Project Sponsor to actively identify these goals and conditions. Requirements risk is associated with all project development activities from earliest concept through PD. Some examples are: meeting NEPA analysis and requirements; establishing local funding sources and requisite local funding capabilities; development of a project organization with the technical capability and capacity to develop the project; and all other relevant areas impacting upon basic project development activities.

- **Design Risk** is associated with the performance and variability of all design-related activities. Design risk occurs when design-related assumptions are incorrect or in situations where unknown factors cause designs to change.

- **Market Risk** is related to the procurement of construction services, materials, and equipment and the variability associated therewith. This risk refers to both the effects of the open-market pricing of goods and services, as well as the effects of the Project Sponsor's contract packaging methods and contract terms and conditions.

- **Construction Risk** includes both risks that are due to the inevitable variability of the project's environment – including such items as unusual weather, unexpected subsurface conditions, and unexpected construction contractor failure – as well as performance risk that is manageable by the Project Sponsor and its consultants and contractors, for example, uncertainty surrounding mobilization of a tunnel boring machine and its planned production rates. Construction risk should be subdivided into Early Construction Risk (composed of Geotechnical/Utility activities, usually associated with approximately a 20 percent completion level), Mid-Range Construction Risk (associated with coordination of contractors, etc.), and Start-Up/ Substantial Completion Risk (associated with approximately 90 percent of construction and/or procurement contracting complete).

Table 3-1 provides a risk checklist from a Project Sponsor's point of view. The checklist reflects the variety of risks that should be considered for an MCP.

3.5.5.3 *Risk Assessment*

A risk management program should provide analysis and assessment of risks to determine the maximum protection and strategies for responding to risks at the earliest time in project development. Particular attention should be given to cost elements that represent high likelihood or magnitude of cost risk (or both) or schedule activities on or near the project's critical path. It is important to keep in mind that risks originate at the earliest stages of a project (requirements risks), extend through PD and Engineering activities (design risks), Risks continue through the construction/procurement bidding cycle (market risks) and into final contract close-outs (construction risks).

In an engineering context, risk can be viewed as a measure of the difference between actual performance or status of project requirements being dealt with, design development, pre-construction (procurement) planning, project control deliverables, outcomes, outputs and the known best practices for performing or satisfying the requirement, the deliverable, etc.

Potential risks that are identified should be evaluated and available mitigation measures identified. The program should provide for an audit in which parameters are rechecked constantly. The project overview by the risk managers should be ongoing, multidisciplinary, and include every significant part of the project.

Table 3-1. Risk Checklist

I. Project Feasibility
A. Technical feasibility
B. Long-term viability
C. Political circumstances

II. Funding
A. Sources of funding
B. Inflation and growth rates
C. Accuracy of cost and contingency analysis
D. Cash flow
E. Exchange rates
F. Appropriation

III. Planning
A. Scope
B. Complexity of the project
C. Technical constraints
D. Sole source material or service providers
E. Constructability
F. Milestones (schedule)
G. Time to complete (schedule)
H. Synchronization of work and payment schedules

IV. Engineering
A. Design and performance standards
B. Unreliable data
C. Complexity
D. Completeness of design
E. Accountability for design
F. System integration

V. Type of Contract
A. Lump sum
B. Unit price
C. Cost plus

VI. Contracting Arrangement
A. Turnkey
B. Joint venture
C. Single prime contractor
D. Several prime contractors
E. Innovative procurement methods

VII. Regional and Local Business Conditions
A. Number of bidders
B. Unemployment rate in construction trades
C. Workload of regional contractors

VIII. Contractor Reliability
A. Capability
B. Capacity
C. Credit worthiness
D. Personnel experience

IX. Owner Involvement
A. Management of project
B. Supplying of material
C. Testing and inspection
D. Safety programs
E. Communications and problem solving
F. Partnering
G. Start-up operations
H. Quality Assurance/Quality Control

X. Regulatory Conditions
A. Licenses, permits, approvals
B. Environmental regulations and requirements
C. Patent infringement
D. Taxes and duties
E. DBE involvement

XI. Act of God
A. Storm
B. Earthquake
C. Flood
D. Fire
E. Impact of site location on any of the above

XII. Site
A. Access
B. Congestion
C. Underground conditions
- Soil conditions (rock vs soil, etc.)
- Water
- Utilities (existing and new)
- Archeological finds
- Hazardous wastes

D. Noise, fume, dust
E. Abutting structures
F. Security
G. Disruption to public

XIII. Labor
A. Productivity
B. Strikes
C. Minority representation
D. Sabotage
E. Availability
F. Work ethics
G. Wage scales
H. Substance abuse
I. Local rules
J. Unions
K. Materials
L. Workman's compensation

XIV. Loss or Damages
A. Owner's responsibility
B. Contractor's responsibility
C. Engineer's responsibility
D. Vandalism, sabotages
E. Accidents
F. Third-Party Claims

XV. Guarantees
A. Schedule
B. Performance
C. Consequential losses
D. Liquidated damages

An assessment of the magnitude of a risk and the comparative impact among several risks will enable attention to be devoted to those risk mitigation measures most valuable to successful project implementation. To quantify the impact of risk, two basic approaches to risk measurement are common:

- *Deterministic Approach* – Past experience is used to estimate the range of impact of a particular risk. Such information could be used to establish a contingency reserve based on the characteristics of a given project. For instance, it is accepted that the risk of underground construction is much higher than at-grade, thus justifying a higher contingency rate for that portion of work. Power distribution, on the other hand, has much lower risk and, consequently, may have a lower contingency factor. The budget for each line item can then be adjusted by its appropriate contingency rate; these line item adjustments are called “allocated contingency”. In turn, these line item allocated contingencies can be summed for all line items to calculate the allocated project contingency. In addition to the allocated contingency there should be a reasoned additional or unallocated contingency that reflects further uncertainties (based on as yet unmitigated potential risks). Combining these two contingency categories (allocated and unallocated) will produce the total project contingency.

- *Probabilistic Approach* – This approach relates various levels of risk exposure to the probability of their occurrence. The objective is to understand the likelihood of needing a certain level of contingency. This approach develops a model to predict the project schedule or cost with various elements of the project treated as random variables. Once the total distribution range of risk (which could be either cost or schedule risk) is known, it is possible to compute the probability of schedule slippage or cost overruns of various magnitudes across the entire project. A few models for calculating total project risk have been developed. The “bottom-up” model, often employed by Project Sponsors that self-perform project risk assessments, accumulates estimated magnitudes of individual identified risks. The “bottom-up” model uses a calculation technique called a “Monte-Carlo simulation” (described below). A second model, the “top-down” model is utilized by the FTA to perform an independent analysis of project risk. The “top-down” model assesses project risk mathematically at a summarized level of cost categories; a more detailed description of this process may be found in Appendix E. Each method has found success in practice, and each method requires practitioners skilled at defining and calculating risk using the respective model.

- The Monte Carlo simulation, used in the “bottom-up” cost model and in all schedule risk assessment, is a randomized simulation used to determine a probability distribution of total project schedule or costs. Tasks and cost items are assigned random durations or amounts within a range of defined parameters, and then the project completion date or total project cost is calculated; this process is repeated hundreds or thousands of times. The percentage of times that a particular project completion date or project cost occurs is tallied, and the result is a graphical representation of the likelihood of completion dates or project costs. If a particular completion date occurs more frequently than any other, it is projected to be most likely to occur in practice. Although the data demands of probabilistic approaches are great and the results may be more difficult to explain to decision makers, the high cost of MCPs justify this sophisticated analysis. Many texts are available that explain this process in more detail.

3.5.5.4 *Risk Response*

Risk response refers to the process of managing risk in the most effective and efficient manner, so that project goals remain intact. Components of a comprehensive approach to risk response include:

- *Risk Avoidance* – This is available when a project element that is associated with certain potential risk events may be alternatively delivered through a less-risky process or design, or may be eliminated altogether. Keep in mind that when a design alternative, or a management process, is selected, there is no guarantee it will avoid the risk unless it is carried out with careful implementation and its deliverable(s) follow a robust project controls mechanism.
- *Risk reduction* – Where possible, the Project Sponsor should take steps to reduce risks, either through reducing the likelihood of a risk event occurring or by reducing the magnitude of loss if a risk event does occur. Examples of risk reduction programs include developing a strong community outreach program for a project, utilizing a well-developed PMP, conducting constructability reviews, having strong project controls, expediting change orders, settling claims promptly, using partnering techniques, performing advance investigations of underground conditions, etc. Insurance may be obtained to reduce the magnitude of a potential risk event. Insurance can be obtained, for example, for Acts of God, and wrap-up insurance or Owner-Controlled Insurance Program (OCIP) can protect against third-party claims even while reducing insurance costs for the project, as discussed later in Chapter 5. Performance and payment bond requirements mean that a surety company takes some responsibility for the contractor's performance. The utilization of an OCIP might be both a cost savings and an incentive for better pricing by consultants, contractors, etc. In short, a well-managed, risk-informed project will have less risk.

- *Risk transfer* – Risks may be contractually transferred to designers, construction contractors, equipment/materials contractors, to other consultants, or to third-party agencies for some situations. For example, for projects of fewer than 24 months, a contractor might be expected to absorb any inflation in prices. Engineers can be expected to be responsible for design errors or omissions. Making contractors purchase their own materials other than long-lead items will eliminate the logistics problems for the Project Sponsor. Contractors should be responsible for accidents, their own worker safety, and for securing the work site and equipment as well as for employee possessions and tools. Caution should be applied when considering risk transfer – risk that is transferred to a party that is not capable of managing or reducing the risk, or that may be incapable of withstanding the consequences of the risk, may price the risk beyond the cost of the Project Sponsor's retention of the risk.

- *Risk sharing* (a form of Risk Transfer)– There are opportunities for a Project Sponsor to share risks with consultants, contractors or other governmental organization in the form of contract requirements, warranties, insurance policies, etc. For example, a Project Sponsor might specify that long-range inflation costs will be shared by some fixed percentage, or that escalation costs will be based on a given index. A Project Sponsor might provide an on-site quality assurance person at a manufacturing facility. Incentives for a good safety record might be provided.

- *Risk acceptance* – This results from the recognition that further reduction of a particular risk would only come at the expense of the project's fundamental goals, such as service loss or cost increase. In some cases, the Project Sponsor must accept risk to avoid excessive bid costs or notices of claims. For example, the Project Sponsor may be expected to accept risks due to political uncertainties, long-range inflation, Project Sponsor-caused delays or other delays beyond a contractor's control, such as, for example, obtaining licenses and permits, Acts of God, or differing site conditions. The Project Sponsor may want to take responsibility for procuring long-lead materials to assure their availability once contractors have been selected, or, in some jurisdictions where appropriate, allow the use of a tax-exempt purchase order from the Project Sponsor. In such cases, the Project Sponsor's protection against this retention of risk takes the form of establishing either cost or schedule contingencies.

3.5.5.5 *Alternative Project Delivery/Contracting Methods*

Alternative delivery and contracting methods have been used to implement many projects. One purpose of these alternative approaches was to assign certain project risks, traditionally borne by Project Sponsors, to contractors. For instance, a single D/B contractor becomes responsible for coordinating the design and construction activities that traditionally involved separate entities for design and numerous construction contractors coordinated by the Project Sponsor. The TDP *Turnkey Evaluation Guidelines* [Ref. 3-26] identified 24 areas of risk associated with MCPs. Table 3-2 [Ref. 2-49] relates examples of instruments for managing those risks and defines possible responsibilities for the Project Sponsor and contractors for alternative delivery methods.

Several of the instruments in Table 3-2 relate to project delivery and contracting methods that are alternatives (described in Chapter 2) to the conventional D/B/B approach that include the following:

- Design/Build (D/B)
- Design/Build/Operate/Maintain (D/B/O/M)
- Concessions – for example, D/B/O/M/Finance (DBOM/F) or Build-Operate-Transfer (BOT)
- Construction Manager At Risk (CMR)/Construction Manager/General Contractor (CM/GC)

One advantage in using D/B, D/B/O/M, or concessions is that the Project Sponsor's project cost risk is reduced earlier in the process because bids are received early – after basic design has been completed. In addition, these contracts may include contractual monetary incentives (and penalty clauses defining liquidated damages) related to the time of completion, retention of key personnel, and adherence to DBE participation commitments, etc. The pre-qualification process combined with best value selection approaches that normally are part of the procurement process significantly increases the assurance that the selected contractor and its approach are best suited to the project.

A fundamental effect that occurs when considering risks under alternative project delivery approaches is that the Project Sponsor not only quantifies risk or makes it explicit through such means as legal contracting language, but, more important, shares the risk with, or transparently shifts the risk to, the contractor. Because the contractor wishes to know in advance who is bearing which risk, it will charge the Project Sponsor accordingly in its bid prices. A beneficial result of a thorough risk analysis and allocation process is a rational assessment of the appropriate risks for the owner to retain, share, or transfer to the contractor. Industry input and review process during procurement will optimized this process.

Table 3-2. Instruments for Managing Risk

Problem Category	Instrument for Managing Risk	Risk Related to Transit MCP	Project Sponsor Responsibility	Contractor Responsibility
Political Assurance	FFGA Record of Decision Letter of Credit Board Resolution	Political	Full	
		Funding	Full	May Participate
		Speculative Effort	Before RFP	Before RFP
Margin of Safety	Reserve Funds Contingency Funds Dedicated Taxes Bonding Insurance Multiple Contracts Indexing	Financing	Full	May Participate
		Inflation	Prior to Award	After Award
		Act of God		Full -Insurance
Hedging		Seismic	Apply Standard	Meet Standard
		Right-of-Way	Full	Up to Full
		Failure to Complete	May Share	Full (capped)
Explication/ Allocation	Fixed-Price Contract Contract Agreements Liability Caps Public/Private Partnership Subordinated Debt	Regulations	Regulatory Changes Only	Full Compliance
		System Integration	Traditional	Turnkey
		Changed Req'ts	Full	
		Operating	Design/Build	D/B/O/M
		Market (Ridership or Revenue)	Design/Build	D/B/O/M (limited)
Contract Performance	Project Mgmt. Oversight Pre-Qualifications Corporate Guarantees Schedule/Cost Reporting QA/QC	Construction Performance	May Share	Full
		Subsystem Test		Full
		System Integration Test	Identify Sub-System Defects	Correct Sub-System Defects
		Schedule	Define Requirements	Conditional Requirements
Risk Minimization	Risk Isolation Information Accommodation Incentive Clause	Bid Exceed Est.	Full	
		Geotechnical	Discretionary	Discretionary
		Hazard. Materials	Discretionary	Discretionary
		Underground Utilities	Discretionary	Discretionary

In addition to the transfer of certain elements of coordination risk to contractors under these alternative contracting forms, other benefits arise, largely due to the increased scrutiny associated with contractual risk allocation. A benefit of Project Sponsor risk assessment and allocation has been the reduction of large risk premiums in bid prices, since Project Sponsors often assume or share risks previously assigned to contractors that contractors were not able to control. Examples include responsibility for unidentified conditions such as hazardous materials, geological aberrations, or heretofore-unknown archeological finds.

If the risk analysis and allocation process is effectively applied to alternative delivery mechanisms, incentives to improve quality, cost-effectiveness and timeliness of a project result. Effective risk allocation can minimize risk premiums and delineate rational strategic risk-sharing plans for difficult to control items such as hazardous materials. As an example, early in the process for the Largo Metrorail Extension, WMATA determined which risks it wished to assume and segregated those elements into a D/B/B site preparation contract reducing risk premiums on the D/B portion of the work.

To the extent that risk is effectively allocated to those parties most able to reduce the probability of adverse consequence or withstand the costs of such consequences, real savings and increased certainty (reduced risk) are possible. There are several key elements necessary to realize this potential. First is the appropriate assignment of risk as indicated. Next is early identification of the risk elements where additional information will increase the contractor's certainty and reduce any risk premiums. Another critical aspect is assuring that the Project Sponsor's contract management and oversight activities do not interfere with the contractor's ability to control its assigned risks, as this may altogether void or reduce the risk transfer.

TDP participants have implemented new approaches to transit development, including such turnkey methods as public/private partnerships, as in the case of the Los Angeles Union Station Gateway, or contractor-based funding/ financing, as in the case of the New Jersey Transit Hudson-Bergen Line. One innovative transit alternative delivery programs involved the FTA's Penta-P program. The Denver Regional Transit District in Colorado pursued a long-term concession agreement under an availability payment structure, where the private party will finance, design, construct, operate, and maintain two new commuter rail lines – the East and Gold. Partnerships such as these allow for sharing of risk and responsibilities, and, given appropriate procurement, contracting and oversight, establish a level of mutual concern, trust, and a new spirit of cooperation. Properly constructed partnerships should align both the Project Sponsor and the contractor goals and focus on mutually agreeable outcomes.

Tools to mitigate risks that are included in most alternative delivery contracts include:

- *Insurance* – used to offset professional liability for design and the risk of injuries and property damage during construction and the O&M of the completed transit project. Project-oriented insurance alternatives allow each contractor to have its own insurance (conventional) and to have a coordinated program provided by the Project Sponsor that covers all project participants (OCIP). It is also common for transit agencies to be self-insured for all or part of its risks associated with O&M.

- *Performance Bonds* – FTA requirements are defined in its third-party contracting Circular 4220.1F, Section 11 [Ref. 2-21]. The practice of surety bonding was developed within the context of traditional procurement approaches, wherein the design and individual construction activities are performed by separate entities and in separate stages of project development. In this environment, the bond provides protection against a construction contractor's failure to meet the design specifications produced by the design firm. An issue that has arisen with large single-contractor (e.g., D/B and turnkey) procurements is the capacity of the surety industry to insure for the full value of the contract. This particularly creates a problem for large contract sizes – it limits the number of proposers who can compete and may impose an unnecessarily high cost for such bonds, which do not provide sufficient incremental value. Reduction of bond requirements in such circumstances may be considered in discussion with the FTA.

- *Parent Guarantees* – Parent company guarantees are a standard requirement of most procurements that involve either large projects or those being submitted from a consortium that has developed a special purpose entity. This formal back-up guarantee holds the large parent company liable for assuring that the contract terms are met.

- *Financial Guarantees* – Where the private party is responsible for providing financing for the project there is also the requirement to provide alternative forms of security such as irrevocable letters of credit from major banks. The government may draw on these letters of credit in the event the private party fails to close the transaction.

- *Partnering* – a process to improve the relationship between Project Sponsors and their contractors (see Section 3.6.4).

- *Contingencies* – incorporated in cost estimates and schedules to account for the risk associated with uncertainties, be they design application, unknown site conditions, etc.

3.5.6 Project Documentation and Reporting

Cost and progress reporting should be integrated with the schedule planning and reporting system. The integrated cost/schedule/progress reporting system should provide management with promptly issued, accurate data on costs, budgets, and the progress of the many entities of the organization. The Project Sponsor should require reports of the principal project tasks at the frequency and in the format necessary to monitor the project. Frequencies of at least monthly are necessary, and even weekly or biweekly may be warranted for specified activities or tasks. The Project Sponsor also has an obligation to prepare reports at least quarterly on the project's financial status and to provide such reports to the sponsoring government agencies.

Detail and summary level reports should provide periodic and cumulative costs, comparison of actual costs to the planned costs of each element of work, analyses of any variances from the planned costs which may occur, cost relationships with schedule and progress, and variations in the defined scope of project work. The system should include reporting of engineering and administrative costs as well as construction and procurement costs. The system should provide forecasts of the expected costs of work packages at completion and of the total project.

In addition to routine cost forecasting, as design develops and contracts for materials, equipment, and services are awarded, provisions should be made for periodic reviews and updates (conducted from an overall management perspective and preferably monthly, or on at least quarterly or semiannual basis) of the system-wide estimate. Elements of the project’s cost estimate should be subject to varying degrees of re-estimating depending on the status of project development, changes in previously predicted economic conditions, unfavorable experience in contract awards, or refinement of quantities. Project managers should determine the degree to which re-estimating is to be performed, recognizing its cost and the extent to which it will interfere with ongoing performance. Schedule impacts are essential for consideration in conjunction with these periodic cost estimate reviews, as time is both money and in the case of a project under an FFGA essential to understanding whether or not alternative courses of action are necessary to comply with the contracted RSD. The cost/schedule/progress reporting system should include an exceptions report that focuses on current problems or items that appear to be causing problems and proposed solutions to those problems. The exceptions report should also indicate perceived changes in material costs, labor rates, and cash flow that may occur. Anticipated areas of concern and specific problems should be identified and discussed.

Current practice in large transit construction projects is to require contractors to develop cost loaded construction schedules, which are used as the basis for progress reporting and payment requests. It is also a growing practice in the design area to provide metrics to evaluate performance of consultants (and staff or third parties); adopting “earned value” techniques with contracts and accounting/reporting practices is one means toward this sound risk-informed project management approach.

Additional Project Sponsor project reports for updating as warranted by changes and/or progress should include the following:

- Updates of the Project Management Plan (PMP)
- Updates of the Project Procedures Manual (PPM)
- Documentation Control, Records and Configuration Management
- Document Control Logs
- Updates the RCMP for MCPs and others as warranted
- Updates of the project Quality Assurance Plan and Quality Control Procedures
- Updates on Quality Control activities, especially related to interdisciplinary reviews and the satisfactory closure of all review comments
- Updates on the Real Estate Acquisition Management Plan and the program status
- Schedules and Updates
- Project Progress Photographs
- Reports to Management
- Cost Accounting and Reporting
- Lessons Learned Program

In all cases of substantive change in cost, schedule or functionality, the relevant Work Breakdown Structure (WBS) dictionary and definitions by WBS of activities should be updated whenever changes occur. It is essential for all involved to make WBS updating mandatory for design phase and construction phase activities, and especially for cost estimating and scheduling WBS details.

3.5.7 Available Technology for Project Management

Today, project managers are able to use personal computers armed with the latest in project management software to perform a host of functions once done by hand. Project management software now assists the manager in project planning, cost estimating, project administration, scheduling, document control and configuration management, and data management. The Project Sponsor should define technology requirements for all consultants to assure compatibility. The following sections discuss typical capabilities of full-powered project management software.

- *Project planning* - This relates project activities to time, required resources, and any required preceding activities. Activities can be specified by sequence or precedence, such as how the activities depend on each other and which must be completed before others can begin. The program can determine the project's critical path, which is the sequence of activities that must be done on time if the project is to be completed on schedule. Project planning can be accomplished in concert with the essential Work Breakdown Structure (WBS) developed for the project.

- *Resource management* - After breaking the project into tasks and their relationships, available resources must be identified, allocated, and assigned to each task. Programs permit "resource leveling," the process of smoothing out the use of resources over time to meet constraints on resource availability. The “earned value” techniques are also made more efficient, transparent, accurate, and effective for the planning and design activities of staff and consultants.

- *Tracking progress* - Start and finish dates and other scheduling matters can be determined using project management software, after which actual progress can be assessed. Various displays are possible that permit comparison of actual to the baseline.

- *Reports* – Graphs and plotted reports of the project’s plan and status are additional program tools that can ease updating project reports, including:
  - Network diagram – CPM or PERT charts that show all project activities and their precedence relationships, as well as status comparisons to planned progress on deliverables, outcomes, etc.
  - Gantt (bar) charts, which show each activity as a horizontal bar extending along the project timeline, milestones, and planned activity progress versus actual progress.
  - Network schedule, which is a tabular listing of all project activities with their earliest and latest start and finish dates that also shows how much float, or slack time, each activity has.
  - Resource reports, which include a tabular listing of all resources and their assignment to activities. Resource histograms, vertical bar charts showing assignment of resources over time, are also possible. Some histograms also show load limits such as the maximum allowable assignment of a resource.

- Cost and Schedule reports that provide detailed breakdowns of assigned costs and time are a minimum requirement. Cumulative cost reports that depict cash flow requirements prove useful as well, and more powerful programs will calculate and graph out earned value as the project progresses. An "earned value" graph compares project completion with costs expended. These reports will also show the estimated cost and/or time to complete the project.

Numerous project management software packages are available for various phases of a transit capital improvement project. The Project Sponsor must define its requirements for record keeping and compare the products. After considering periodic reviews in publications or discussing its needs with other recipients, managers should consider the software cost, capabilities, user friendliness, training requirements, flexibility, and available tech support. Project Sponsors also must be sure that requisite software and RFPs identify process requirements or Requests for Bids, spelled out in contracts, and, lastly, enforced to affect and realize their benefits.

3.5.8 Managing Hazards and Threats

Risk management is a well-known component of project management. Less well known are two aspects of managing risk that FTA Circular 5800.1 mandates as part of the SSMP, itself part of a project's PMP. These are a Hazard Analysis and a threat and vulnerability analysis. Both entail processes that are similar to risk analysis, but each has unique aspects and each requires skills particular to safety (in the case of hazards) or security (in the case of threats and vulnerabilities) analysis and management.

A hazard analysis is a safety study, while a threat and vulnerability analysis is a security study. The difference between safety and security is in intention; safety is defined as freedom from *unintentional* harm, while security is freedom from *intentional* harm. This section outlines hazard analysis and threat and vulnerability analysis procedures and requirements. Both must be successfully conducted and documented for a project to receive an FFGA.

Hazard and threat analysis programs should be established in all major transit projects. If the Project Sponsor's safety or security staff is not large enough or knowledgeable in Hazard Analysis and resolution or threat and vulnerability analysis and resolution, consultant staff may undertake this role, but, as in all SSMP components a specifically identified Project Sponsor staff member must be responsible for and must oversee the consultant's work.

In situations where an architectural or engineering firm is responsible for a project's design, a safety or security sub-consultant may undertake the Hazard Analysis and/or the threat analysis as part of the package of plans that are submitted to the Project Sponsor. Both analyses must be updated at each phase of the project, and the PD Phase should include the first iteration. Depending on a project's size and scope, the Project Sponsor should consider separate safety and security assessments for civil and system components of a project.

Although there is considerable overlap between hazard and threat analyses, each is discussed separately to assure that project managers understand the key differences and do not allow the similarities to blur the need for each type of analysis to be undertaken by an experienced professional and managed by a responsible project staff member.

3.5.8.1 *Hazard Analysis and Management*

In general, the Hazard Analysis most common for major transit projects is the Preliminary Hazard Analysis (PHA) while the process itself is sometimes called Hazard Assessment and Resolution (HAR).

The PHA is often developed prior to the engineering phase, but is referred to as a “living document,” because hazards will change over a project’s lifecycle, which is the reason the PHA must be updated at each phase of a project.

Similar to the PHA, the Operating Hazard Analysis (OHA) identifies and mitigates hazards associated with testing, training, operations, maintenance, and emergencies. The OHA is typically conducted after construction by subject matter experts familiar with the systems and subsystems, including operators, supervisors, maintenance personnel, first responders, test leads, and contractors.

Hazard analysis is a process that is used to identify, analyze, and resolve potential hazards related to elements of a transit system or project. Hazards may be caused by personnel, passengers, system visitors, contractors, or by project facilities or equipment.

In developing a hazard management program, Project Sponsors should be guided by:

☞ DOT’s Hazard Analysis Guidelines for Transit Projects (2000) [Ref. 2-54]

Projects subject to FRA requirements, such as commuter rail projects, may also need to conduct a collision hazard analysis (CHA).

☞ *Collision Hazard Analysis Guide, Commuter and Intercity Passenger Rail Service* (2000) [Ref. 3-27]

The hazard analysis guidelines presented here are based on the U.S. Department of Defense document “System Safety Program Requirements,” MIL-STD-882. The disciplined, structured approach outlined in MIL-STD-882 allows hazards to be systematically identified, analyzed, and addressed. The MIL-STD-882 methodology also ensures adequate review of all hazards and mitigation strategies.

☞ Department of Defense Standard Practice System Safety MIL-STD 882E (2012) [Ref. 3-28]

The steps in a hazard (safety) analysis, similar to risk analysis, include:

- Identifying known hazards
- Categorizing the hazards based on their potential severity and probability of occurrence (similar to risk management’s step in assigning risk)
- Analyzing the hazards for potential impact
- Resolving each hazard by relying on such alternatives as design, engineering, use of warning devices, procedures and training programs to counter the hazards, or through any variety of other methods

- Project managers must continuously monitor the project to evaluate the performance of measures instituted

3.5.8.2 *Hazard Identification*

The objective of hazard identification activities is to define those conditions and faults that have potential for causing an accident.

Hazard identification is the most critical step in a PHA; if a hazard is not properly identified, it will not be measured and its potential to cause damage to the project will be ignored. The FTA lists five basic methods for hazard identification. They are:

(1) Data from previous accidents or operating experience; these are similar to case studies, where a past event is analyzed to determine how it can be prevented in the future
(2) Scenario development and judgment of knowledgeable individuals
(3) Generic hazard checklists
(4) Formal Hazard Analysis techniques
(5) Design data and drawings

3.5.8.3 *Hazard Measurement*

Once Identified, hazards are measured in terms of the consequences that would occur if they were to be activated (their severity). For hazards whose consequences are not negligible, the analysis must determine the probability (or frequency) of such occurrences.

The transit industry relies on four categories to provide a qualitative measure of outcomes: catastrophic, critical, marginal, and negligible. They are illustrated in Table 3-3.

Table 3-3. Hazard Severity Categories

Severity Category	Consequences of Occurrence
I Catastrophic	Death, system loss, or severe environmental damage
II Critical	Severe injury, severe occupational illness, major system or environmental damage
III Marginal	Minor injury, minor occupational illness, minor system or environmental damage
IV Negligible	Less than minor injury or occupational illness, less than minor system or environmental damage

3.5.8.4 *Hazard Probability (Likelihood or Frequency)*

Once the severity of a hazard is determined, the analysis team must consider the probability (likelihood) of it occurring. Here, too, recognized categories are used: frequent, probable, occasional, remote, improbable, and eliminated. These categories are illustrated in Table 3-4.

Table 3-4. Hazard Probability Categories

Probability Level	Individual Item Probability	System-wide Probability
A Frequent	Likely to occur frequently	Continuously experienced
B Probable	Occurs several times in item's life	Likely to occur frequently
C Occasional	Likely at least once in item's life	Occurs several times
D Remote	Unlikely, but possible to occur	Can be expected to occur
E Improbable	Assume no occurrence	Unlikely, but possible
F Eliminated	Incapable of occurrence	Hazards are eliminated

3.5.8.5 *Risk Determination*

Each hazard that is identified must be assigned a severity (I, II, III, or IV) and a probability (A, B, C, D, or E). This results in its consequence being defined by one of 20 risk indices. For example, the highest Hazard Risk Index (HRI) would be labeled I-A (representing 1 = catastrophic and A = frequent) and the lowest HRI would be labeled IV-E (representing IV = negligible and E = improbable).

Because it would be cumbersome to work with so many indices, the FTA hazard guidelines rely on only four HRIs. They are illustrated in Table 3-5a and b.

Table 3-5a. Risk Categories and Determination

Risk Category	HRIs in Risk Category	Acceptance Criteria
High	I-A, I-B, I-C, II-A, II-B,	Unacceptable
Serious	I-D, II-C, III-A, III-B,	Acceptable with review
Medium	I-E, II-D, II-E, III-C, III-D, III-E, IV-A, IV-B	Acceptable with review
Low	IV-C, IV-D, IV-E	Acceptable

Table 3-6b. Risk Assessment Matrix

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			

3.5.8.6 *Hazard Resolution (or Mitigation)*

Risk resolution (or mitigation) provides a guide to how management must mitigate the risks that have been identified and quantified. The resolution will be based on the determination of risk category. Thus, if a hazard is:

- *High* – The risk cannot remain and must be mitigated, which means that executive-level management must direct project managers to eliminate the risk or reduce it to a lower, acceptable category.
- *Serious/Medium* – The risk is undesirable and should be reduced.
- *Low* – The risk is acceptable with review by management. In low risk situations, management may decide to leave the hazard in its plans but may identify it for future action that would further reduce the risk.
- *Trivial* – The risk is acceptable; no action need be taken to address a risk that the analysis team places in this category.

The standard order of priority for mitigating hazards should be followed to bring a hazard to an acceptable risk level. The transit industry recognizes the following priority for mitigation of defined hazards:

- Design to eliminate the hazard
- Design safety device(s) to control the hazard
- Design warning device(s) for the hazard
- Develop procedures and provide training to better manage the hazard

3.5.8.7 *Threat and Vulnerability Management*

A Threat and Vulnerability Analysis (TVA) is the security counterpart of the PHA (or HAR) process. Like the PHA, the TVA must be updated at each phase of a project, because threats will change over a project's lifecycle.

The main goal of a TVA is to assess threats at each phase of a project and to assure that existing security mechanisms in place provide satisfactory provisions for the detection, deterrence, and response to malevolent acts in the planning, design, construction, and operation of a transit system. Where existing systems are not satisfactory, the TVA should recommend improved mitigations for management to select to lower the vulnerability of the project.

Generally, two principle goals are established for all TVAs:

- The security and well-being of the local community, general public, contractors, patrons, and employees are given top priority in all phases of a project's development, culminating in an operating system where people may move freely throughout the system with a high level of actual and perceived security
- The protection of facilities and equipment should reduce potential problems that could lead to disruption of the project during developmental phases or of the system once it is operational; problems might include increased maintenance, operating, and legal costs associated with disruptions caused by foreseeable events

The definition of security is, in some ways, broader than that of safety and, therefore harder to quantify. In addition, safety is a well-established discipline within the transit industry and within all construction projects; security, on the other hand, has historically been treated as an adjunct of safety, with little direct focus on it except in very large transit systems with their own in-house police departments.

One way project managers can assure that security receives appropriate attention is to separate the two fields in their thinking and in their actions. Rather than continue to assume that the word "safety" also includes security, recipients and project managers must recognize that the two are different, require different types of expertise, and must be addressed separately in meetings, bid documents, and in oversight of all phases of a project.

In developing a threat and vulnerability assessment, Project Sponsors should be guided by:

☞ FEMA's Threat and Hazard Identification and Risk Assessment *Guide [Ref*. 3-29]

3.5.8.8 *Threat Identification*

Complicating the study of threats and vulnerabilities is that the tasks go beyond traditional crime fighting. Criminal threats are the most common to consider; they include property crimes, larcenies, fare evasion, theft from patrons, vendors, employees or vehicles, and violent crimes, such as robberies and assaults. Less common types of intentional wrongdoing that must be analyzed include the possibility of terrorist acts, civil disturbances, sabotage, pilferage, theft of property or information, workplace violence, extortion, or other willful attacks on the system, its property, or its patrons.
Undertaking such an analysis involves asking:

- What can go wrong?
- What is the likelihood of it going wrong?
- What are the consequences of it going wrong?

3.5.8.9 *Defining Vulnerability*

Vulnerability is defined as the susceptibility of a location to a particular threat. Once probable threats are identified, a vulnerability analysis considers the potential impact of loss if a facility were to becoming disabled or destroyed.

Impact of loss is further defined as the degree to which the agency's mission (or a particular portion of the agency's mission) would be impaired by the success of a particular threat being carried out. In a transit system, vulnerability increases or decreases as a result of:

- System design
- Equipment (and technology) used
- Operating procedures
- Policing and/or security operations and safeguards

3.5.8.10 *Threat Severity*

As with Hazard Analysis, the measurement of vulnerability relies on industry-wide accepted categories to provide a measure of the potential outcomes of security breaches. The categories are the same as in hazard measurement, including catastrophic, critical, marginal, and negligible. Table 3-7 summarizes these categories.

Table 3-7. Threat Severity Categories

Severity Category	Consequences of Occurrence
I Catastrophic	Death, system loss, or severe environmental damage
II Critical	Severe injury, severe occupational illness, major system or environmental damage
III Marginal	Minor injury, minor occupational illness, minor system or environmental damage
IV Negligible	Less than minor injury or occupational illness, less than minor system or environmental damage

3.5.8.11 *Threat Probability (Likelihood or Frequency)*

Similar to the hazard analysis process, the probability of the frequency of occurrence of each threat must be estimated. The likelihood that a breach will occur is generally described in terms of potential occurrence per unit of time, event, population, or activity. The probability will differ with the different phases and elements of a project.

Certain breaches are more likely to occur during construction than during revenue service; for example, thefts of equipment or of employee tools are examples of breaches more closely associated with construction sites than with revenue service. Similarly, the location of a construction site or a station in a high-crime area must be considered in the analysis of threat probability.

More dramatic breaches, such as, for instance, an eco-terrorist attack on an unpopular construction site or an international terrorist attack on a rail station, also differ in their likelihood under different sets of circumstances. A construction site that abuts popular parkland or wetlands and is opposed by environmentalists has a higher likelihood of attack than one in an uncontroversial area. International terrorists are more likely to attack a heavily trafficked station located in or adjacent to a historic site than a small, suburban walk-up station that is little more than a platform and a shelter. The latter may be more easily breached, but the small amount of publicity and loss of life that would occur make the event less likely.

Bearing these and similar scenarios in mind, analysts will define the threat/vulnerability probability using the same five categories as in Hazard Analysis: frequent, probable, occasional, remote, or improbable. Table 3-8 summarizes these categories.

Table 3-8. Threat Probability Categories

Probability Level	Individual Item Probability	System-wide Probability
A Frequent	Likely to occur frequently	Continuously experienced
B Probable	Occurs several times in item's life	Likely to occur frequently
C Occasional	Likely at least once in item's life	Occurs several times
D Remote	Unlikely, but possible to occur	Can be expected to occur
E Improbable	Assume no occurrence	Unlikely, but possible

3.5.8.12 *Criticality*

The final step in the threat analysis is to establish security objectives. To do this, the severity of a breach and the likelihood of its occurrence are combined to form a risk level (criticality) matrix that follows a format similar to that for the determination of hazards (high, serious, and low), as summarized in Table 3-9.

If a threat is:

- *High* – The risk cannot remain and must be mitigated, which means that project managers must eliminate the risk or reduce it to a lower, acceptable category.
- *Serious* – The threat is undesirable and should be reduced, if at all possible within fiscal constraints. The decision how and when to institute mitigation measures is a decision to be made by executive-level management.
- *Low* – The risk is acceptable; a review by executive-level management may result in no action taken immediately and the threat being permitted to remain, possibly with an identification of future action that would further reduce the risk.

Table 3-9. Criticality Matrix

Severity→ (decreasing) Frequency↓ (decreasing)	**I**	**II**	**III**	**IV**
A	H **(I-A)**	H **(II-A)**	S **(III-A)**	S **(IV-A)**
B	H **(I-B)**	H **(II-B)**	S **(III-B)**	L **(IV-B)**
C	H **(I-C)**	S **(II-C)**	L **(III-C)**	L **(IV-C)**
D	S **(I-D)**	L **(II-D)**	L **(III-D)**	L **(IV-D)**
E	S **(I-E)**	L **(II-E)**	L **(III-E)**	L **(IV-E)**

H = High

S = Serious

L = Low

3.5.8.13 *Countermeasure Recommendations*

The final step in a TVA is recommendations for countermeasures. These may combine physical and human security. In some situations, barriers, entry/exit policies, access control mechanisms, and/or intrusion detection or surveillance systems including closed circuit television (CCTV) may be among the countermeasure recommendations. Human security may involve guards at key locations, whether checking badges or employees, contractors, or visitors, maintaining pedestrian or vehicular traffic control, checking in and out deliveries, or patrolling regularly or spot-checking a site during non-working hours.

Recommended countermeasures must take into account the application of Crime Prevention Through Environmental Design (CPTED) and Situational Crime Prevention (SCP), such as techniques relying on design, landscaping, signage, placement of entrances/exits, and a variety of planning techniques that create a sense of security at a site.

Because of the changing nature of projects through their life-cycle phases, the countermeasures may also change. Additionally, external events may also influence the recommendations. For instance, a popular, well-received project may not require the intense mitigation strategies that an unpopular project may require, just as traffic patterns and crime levels in a surrounding area will influence the types of mitigations recommended.

In developing countermeasures and designing for security, Project Sponsors should be guided by:

☞ Transit Security Design Considerations (2004) [Ref. 2-59]

3.6 Procurement, Contracts, and Related Topics

3.6.1 Procurement

Mandatory clauses in FTA Circular 4220.1F determine the provisions that apply to the particular procurement, including policies and procedures for obtaining professional, construction, and other services, ROW, and materials and equipment. In addition, the Project Sponsor needs to determine which statutes and regulations presented in the FTA Best Practices Procurement Manual (BPPM) apply to the project.

☞ FTA Circular 4220.1F (Third-Party Contracting Guidance) [Ref. 2-21]

These should address requests for procurement, selection criteria for contract awards, types of contracts, schedules, price and cost estimates, Insurance requirements, and special bonding requirements, if any. Responsibility and authority should be assigned for preparing, negotiating, executing, and monitoring all contracts from both a technical and administrative perspective. This calls loudly for a Source Selection Plan, with associated procedures, to be developed that covers this process either at the total project level or further broken down for individual contracts.

A procurement plan should be prepared for each phase to acquire all required services and items in accordance with the mission and objectives of that phase. The size and content of each procurement package, schedule for delivery, and cost estimate should be included. Specific requirements for procurement functions should be established in accordance with the suggested guidance and as documented in the Project Sponsor's Source Selection Plan:

- *Procurement documents* – Professional services and bidding documents should include a description of the contract work scope, the form of contract to be awarded, the schedule for completion (inclusive of interim milestones that may be necessary) and the requirements for the technical, management and cost portion. The documents should also describe the process to be used in selecting consultants or bidding, proposal evaluation, and contract award.

- *Procurement certification checklist* - A checklist that identifies all actions to be completed prior to advancing a procurement and the individual(s) responsible for each action should be developed. All responsible parties should certify by signature that action items have been completed and that the package is prepared for advertising.

- *Advertising* - For each procurement, a list of potential consultants and/or bidders who have demonstrated capability to provide the service or item in compliance with specifications should be prepared. All listed firms should be invited to propose (consultants) or bid (contractors) on the procurement. The availability of proposal and bid documents should be advertised in trade publications such as *Passenger Transport* and *Mass Transit*, in small business, minority, and women-owned trade publications, and in other media, including newspapers published and circulated in minority communities.

- *Pre-Proposal and Pre-bid conferences* - Pre-proposal and pre-bid conferences should be conducted to brief prospective consultants and/or bidders and explain the procurement requirements. Any pertinent changes to proposal and/or bid information resulting from the conference should be issued to all recorded holders of the bid documents.

- *Contractor selection* - Evaluation of the proposals or bids should be made by a designated team representing the owner and in accordance with a prescribed process.

- *Pre-award survey* - Prior to contract award, a pre-award survey may be appropriate to ensure that the selectee possesses the personnel, facilities, procedures, financial resources, and experience to complete the contract satisfactorily. In some cases for construction and/or major procurements, it may be appropriate to pre-qualify prospective contractors prior to the bidding process, thus eliminating the need for the pre-award survey.

- *Contract award* (construction and/or procurement contracts) - If the pre-award survey finds that the prospective contractor is satisfactory, a contract should be prepared and executed. If not, the pre-award survey process should be repeated with the next ranked bidder until a satisfactory contractor is identified.

- *Monitoring and control* - Monitoring and control of the consultant's and/or contractor's work should be accomplished in accordance with the QA plan and the specifications of the contract.

The DBE requirements of all applicable jurisdictions, including FTA, should be identified. Contracting opportunities should be pursued in concert with the Project Sponsor's DBE officer as part of each procurement to achieve the project's goals. Availability identification and analysis by contract work type is important for providing sound, defensible DBE goals and enabling the Project Sponsor to provide lists of available and qualified DBE firms to prospective consultants and/or contractors.

In planning for procurement, the Project Sponsor must consider the importance of work packaging, which relates to the number and size of individual contracts. The smaller the number of individual contracts, the smaller the number of problems there may be with administration and coordination. Larger contracts may attract interest from larger, more experienced contractors from outside the immediate geographical area to enhance the competition. However, they may also reduce the competitiveness of local contractors. Work packaging should be coordinated with DBE goals to have contracts available on which these contractors are able to participate. In this latter regard, prime contractors may be more inclined to aggressively pursue and utilize qualified DBE firms when the contract work schedule of pricing is broken out (line itemed) by the Project Sponsor such that the prime contractor can easily seek bids from these firms and permit easy assignment of specific and possibly unique-to-the-DBE project activities. This approach may also enable the DBE firms to avoid such potential issues that have cropped up, such as side-by-side non-union and union work, as well as provide a clearer DBE firm role that it can then market for future business.

3.6.2 Consultant and Contractor Selection and Contract Types

Negotiated contracts and advertised, competitive-bid contracts are the primary methods for selecting potential professional services and construction/procurement contractors. It is important to check state or local laws that may impose requirements on the procurement process that might prohibit or otherwise make difficult one or more contract types. Competitive bidding is better suited to lump-sum and unit-price contracts rather than to cost reimbursable contracts. Listed in order of decreasing contractor responsibility for performance cost, are the type of contracts that may be considered:

- Lump-Sum, Firm-Fixed-Price
- Fixed-Price with Escalation
- Fixed-Unit-Price
- Fixed-Unit-Price with Escalation
- Cost-Plus-Incentive-Fee

- Cost-Plus-Award-Fee
- Cost-Plus-Fixed-Fee

In general, fixed-price type contracts provide for performance of specified work in consideration of a stated price, and the contractor is obligated to accept the risks of uncertainty. These are most applicable to contracts involving materials, equipment, and facility construction. Cost-reimbursable type contracts provide for the payment of allowable costs incurred in the performance of the contract and establish a cost ceiling that the contractor cannot exceed. These types of contracts are best when uncertainties exist which prevent the preparation of a precise work scope and cost estimate. Cost-reimbursable contracts are most appropriate for professional service contracts; they require the contractor to have a sound cost accounting system. The Brooks Act (40 U.S.C. Chapter 11) constrains the selection process for architect/engineer contractors; FTA has permitted exemptions where State laws allow alternatives.

Additional information related to procurement and selection for alternative delivery approaches is included in Chapter 2.

3.6.3 Dispute Resolution

Responsibility should be assigned and procedures clearly established for resolving disputes in a timely manner and at the lowest administrative level possible. Clearly, the best way to deal with disputes is to avoid them by mitigating the conditions that cause them. Dealing with contingencies in the framework of contract documents can help to avoid disputes. The recognition of contract elements that are vulnerable to change and misinterpretation can help stem disagreements. Clauses dealing clearly with (for consultants) clearly written work scope, assignment of qualified staff, work location, financial and administrative accounting and reporting, and quality assurance/quality control. Deliverables, etc. and (for contractors) changed conditions and quantity variations should be included in the contract document. In general, disclaimers and exculpatory language should be avoided. Both the owner and consultant and/or contractor should agree to language that permits the project to advance while any dispute is being resolved rather than bringing the consultant’s and/or contractor's work to a halt. The selection of formal dispute resolution procedures should be a function of the project size and the Project Sponsor’s resources and may include:

- Dispute Review Board
- Arbitration
- Mediation
- Litigation

For information on disputes see:

☞ Avoiding and Resolving Disputes in Underground Construction: Successful Practices and Guidelines [Ref. 3-30]

3.6.4 Partnering – Construction Contracts

There has been an increasing desire on the part of Project Sponsors and contractors to foster an environment that is less adversarial and based on a desire to achieve mutual objectives. A concept called *partnering* emerged that aims at creating an environment where trust and teamwork prevent disputes and stakeholders establish bonds to complete a project successfully. Partnering can apply to any stakeholder relationships; it involves the Project Sponsor and its contractors, including the design team, construction contractor(s) or equipment supplier(s), or, in some cases, a large multidiscipline D/B or D/B/O/M consortium.

This process begins by establishing a voluntary Partnering Agreement. The partnering process continues with a workshop whose sole agenda is to establish and implement the partnering process. Holding similar workshops throughout the project will reinforce the initiative.

The key elements of a partner agreement are:

- Strong commitment by top management to the process, both owners and contractors
- Equity of all stakeholders in the process
- Trust between the parties
- Development of mutual goals and objectives
- Continuous evaluation of the process to ensure that all parties are working towards the goals and objectives
- A method for achieving timely response to concerns

Partnering itself will not eliminate all claims but, used in conjunction with other claims management techniques, it may help with claims resolution by encouraging mutual trust and by specifying mutually agreed upon procedures for resolving issues. Sources of information on dispute resolution and partnering are available from the Construction Industry Institute.

3.6.5 Claims Management

A claim is a written statement by a single party requesting additional time and/or money for acts or omissions by another during performance of a contract. From a Project Sponsor's standpoint, claims have become the administrative vehicle whereby Project Sponsors and contractors may equitably allocate the costs of events that occur outside the scope of the contract. From a contractor's perspective, claims can be just compensation for unforeseen cost overruns or a means by which to expand the value of the contract and increase the profit.

No project is totally secure from the risk of cost increase due to claims related to changed conditions and authorized additional work. Project cost overruns due to claims may be attributed to one or more of the following problems:

- Failure to provide for risk allocation in the contract
- Inclement weather or other uncontrollable natural events
- Ambiguities in or poorly developed contract provisions and contract drawings
- Strikes
- Poorly prepared specifications
- Acquisition of permits and approvals from outside agencies
- Failure to establish and implement management procedures capable of reducing exposure to unnecessary risk
- Site accessibility problems
- Extension of time, design or requirement changes, etc., granted to an interfacing contractor which causes delays or changes to the performing contractors
- Inadequate or non-existent construction documentation
- Frivolous or unfounded contractor claims

Establishing a claims management process by the project manager is important to avoid the incidence of claims. This starts with the development of a structure and lines of authority that allows responsiveness. This can be accomplished by having a particular manager or supervisor responsible for all of the activities that make up that individual's geographical area. A geographic area might be a line segment, a group of stations, a tunnel, or another clearly delineated area of construction. In addition, authority should go with responsibility. Organizations that delegate authority for authorizing changes or work-arounds to the lowest level possible have good success at claims prevention [Ref. 3-31].

Contract language should be used to allocate risk among the Project Sponsor and the contractor in accordance with the theory that responsibility should be on the party best able to control the risk. See Section 3.5.5 for a discussion of risk assessment and management. The contract structure should be appropriate for the degree of uncertainty in the project and policies and procedures should be written such that they allow project management to act in a responsive manner.

Claims and change order processing procedures should promote early equitable settlements of extras to which the contractor is entitled by answering the following questions [Ref. 3-32]:

(1) Who receives and who analyzes the change order or claim?

(2) What information is required from the construction manager and resident engineer (RE) and in what form(s)?

(3) Will there be support available for review of change orders in the technical group within the owner's organization? Within the consultant organization if such is retained to provide design services during construction?

(4) Will there be an attorney involved early on to analyze if a legal basis exists for the change order or claim?

(5) What levels within the organization will be notified when a change order or claim has been submitted, and to what depth will they be involved?

(6) Will the individual in charge of the project have time to delve into the intricate details to establish whether there is a valid change order or claim and to what the contractor is entitled?

(7) What role do the construction manager and RE play in helping to decide whether there is a valid change order or claim and to what the contractor is entitled?

(8) Will there be a separate department with the responsibility and knowledgeable staff that can assist the project manager in analyzing the change order or claim?

A training program should be considered to ensure the effectiveness of the staff whose responsibility it is to avoid claims.

3.6.6 Alternative Project Delivery Methods and Overall Contracting Plan

Selection of an alternative contracting method depends primarily on the legal environment allowing for such arrangements, implementation objectives, maturity/expertise of the Project Sponsor staff, the Project Sponsor's concern with cost overruns and controlling system costs, tight project schedule, and the decision as to the physical scope of the contract. A summary of the general procurement approach for certain alternative delivery approaches is listed below. Section 2.2.6 provides additional information on these methods along with benefits and constraints.

For all alternative delivery approaches, a key premise of the procurement is to assure that there is clear definition of the responsibilities for each party with a specific statement of the service, how it will be measured, and which parameters are fixed and where there is opportunity for innovation. The approach of Alternative Technical Concepts (ATCs) is often used to allow proposers to submit and receive approval for innovative concepts that vary from the procurement documents. The ATCs are normally kept confidential.

Prior to the formal selection process, the Request for Information (RFI) provides a useful tool in alternative delivery procurement. The RFI is used to seek industry input on the proposed process, provide the opportunity for informal feedback, and identify key commercial issues and solutions.

The selection process itself normally involves a Request for Qualifications (RFQ) that results in a short list of the most-qualified firms. An RFP is issued to those short-listed firms and usually includes three components: Instructions to Proposers, Technical Requirements/Performance Criteria, and the Agreement. The Technical Requirements components will vary depending on the nature of the contracting arrangement but should focus on measurable functional and performance-based elements. The framework needs to be developed through an allocation of contractual responsibility and risk ownership to the party best able to manage the risk. The short-listed proposers are often given the opportunity to provide industry review comments. After any amendments to the documents are made they are reissued and all proposers bid on the revised documents.

- Design/Build (D/B) –The procurement process is normally two-step with an initial pre-qualification of teams based on experience and capability of firm(s) and their assigned personnel with relevant projects and references. Short-listed firms then receive the request for proposal package. The Project Sponsor will normally have design documents available for analysis prepared to a 15-30-60 percent level along with bidding documents that include instruction to proposer, performance-based requirements and a D/B agreement. A typical contract has a guaranteed maximum price (GMP) and a guaranteed completion date. The contract may include warranties of various terms; normally these would be for at least one year. While D/B can be selected solely on lowest price, it is normally a best value selection to take maximum value of innovation opportunities (as further discussed below).

- Design/Build/Operate/Maintain (D/B/O/M) -- The procurement process is similar to D/B with the additional components of assessing operations and maintenance capability. In addition to the construction price, there may also be terms for the ongoing operations and maintenance payments that may be at a fixed price with inflation indices. The O&M payments are tied to achieving stated standards of performance with opportunities for bonus and significant deductions for inferior delivery.

- Concession or D/B/O/M/Finance – The concession procurement process is similar to D/B and D/B/O/M but adds the additional requirement in the qualifications phase of presenting the capability to deliver financing for all or significant parts the project. A concession procurement is a complex set of documents and selection criteria that must address financial, technical and O&M capabilities. There must also be requirements and provisions for the "hand-back" of the facility to the public sponsor. The procurement process normally includes participating in one-on-one meetings. Once the public owner has produced a final set of documents, all bidders are expected to provide bids backed up by letters of credit or other financial commitments. The investment on the part of the private parties in developing their bids and securing financing commitments is significant and it is important to conduct the procurement process with openness and care to maintain a high level of competition.

- Construction Manager at Risk (CMR) or Construction Manager/General Contractor (CM/GC) – The procurement process for the designer and the contractor are both on a qualifications basis. The Project Sponsor chooses the designer and then chooses the CM/CG contractor. The designer selection is the same as a D/B/B although the qualifications will seek those with experience in this type of arrangement. For the contractor the selection covers elements such as experience, project approach, and past performance. The contractor procurement may also include prices for general conditions and the management fee that will be applied to subcontracts.

3.6.6.1 *Best-Value Procurement System*

One important tool to maximize the value from alternative delivery options is use of evaluation criteria that allow selection of the private contractor that will bring the highest value to the public agency. The most effective approaches are when the agency establishes selection criteria based on the agency's policies and goals. Almost all best-value evaluations are based on a two-step process that first establishes the qualifications of proposers and establishes a short-list. When the detailed proposals are submitted, the type of considerations being employed to evaluate include the quality and technical innovations, commitments of key personnel, community outreach programs, minimizing life cycle costs, added-value features and, of course, price.

Table 3-10 provides a comparison of results between more traditional approaches with multiple or single primes vs. two alternative delivery approaches: D/B or D/B/O/M.

Table 3-10. Comparison of Contracting Methods

Feature	Multiple Prime	Single Prime	Design/Build	Design Build Operate and Maintain
Number of Construction Contracts	Many	One	One	One
Type of Technical Specifications	Prescriptive	Prescriptive	Performance	Performance
Acquisition Experience of Project Sponsors	Moderate	Extensive	Low	Low
Project Sponsor Involvement and Coordination Demands	Extensive	Moderate	Low*	Low*
Expected Claims Change Orders, and Back Charges	High	Medium	Low	Low
Operating Risk Exposure to Vendor	Low	Low	Low	High
Proprietary Technology Admissible	No	No	Yes	Yes

* While some coordination responsibility can be assigned to a contractor, the Project Sponsor must maintain overall public interface responsibility.

Lessons learned from FTA's Turnkey Demonstration Program (TDP) are documented in:

☞ *Lessons Learned – Turnkey Applications in the Transit Industry* [Ref. 3-33]

With a wide range of project development approaches offered by turnkey, acquisition planning, including whether to proceed with turnkey implementation, and if so, what type of turnkey is very important. Turnkey requires more effort and concentration in project development, with less in engineering, construction, and contracting requirements on the part of the public sponsor. Turnkey also requires different management and professional capabilities on the part of the Project Sponsor as contrasted to conventional procurement. Turnkey can benefit agencies with less technical and engineering resources or those with projects under tight financial and schedule constraints, as it can result in cost savings due to shorter inflation periods.

In the past, constraints such as the Federal public competitive bidding policies and the Brooks Act restricted the ability of a Project Sponsor to pursue anything but a conventional procurement approach.

Additionally, many state licensing statutes prohibit design services by unlicensed architect and engineer (A&E) entities. In effect, these state statutes prohibit the Project Sponsor from contracting with any other entity than an A&E to accommodate alternative contracting, distinct from traditional legal forms of contracting. Many of the TDP and other transit projects using alternative delivery methods had to enact special legislation or receive waivers to permit various elements of the D/B process. As D/B and other contracting approaches became more common there was a significant increase in the number of states that passed legislation that to some degree identifies, supports, or encourages the combining of design and construction on public projects.

3.6.6.2 *Build America Transportation Investment Center (BATIC)*

The Build America Transportation Investment Center (BATIC) serves as the single point of contact and coordination for states, municipalities and Project Sponsors looking to utilize Federal transportation expertise, apply for Federal transportation credit programs and explore ways to access private capital in public private partnerships.

BATIC addresses the procedural, permitting, and financial barriers to increased infrastructure investment and development by:

- Intervening earlier in project lifecycle
- Actively helping sponsors navigate and accelerate the often complex Federal permitting and procedural requirements,
- Centralizing project coordination and
- Cultivating public private partnerships

BATIC drives efficiencies and creates further financing optionality for projects in a shorter timeframe helping to accelerate the repair and development of critical US transportation infrastructure. Details are available at the DOT's BATIC website.

3.6.7 Contracting Considerations Related to Risk Management

The following considerations relate to the use of alternative project delivery and contracting methods:

- *Number of Construction Contracts* – For many alternative project delivery methods, there is only one contract wherein the Project Sponsor (or a Project Sponsor's hired construction manager consultant) performs oversight while the contractor focuses on the performance of the contract. Multiple primes are typically used on projects by agencies that are large and mature, and have a knowledgeable and experienced staff that has managed large projects in the past. The packaging of work into multiple, smaller contracts stimulate smaller local and DBE contractors but may require using a combination of D/B/B and alternative delivery approaches. This "portfolio effect" is achieved by spreading the risk to many contractors; however, it must be weighed against increased project management and control demands.

- *Acquisition Planning* – In the conventional approach to implementing transit projects, the Project Sponsor assumes full responsibility for the design, system integration, phasing, procurement of construction, management interface, and quality assurance of the entire project wherein acquisition planning is a somewhat phased activity. In alternative project delivery methods, the contractor may have the full responsibility for project implementation from design through start-up, and possibly O&M. Acquisition planning under these approaches requires a more concentrated, detailed, and long-range effort up front. Although there may be a single contract under D/B or D/B/O/M, the level of contract formation defines whether the project will be a success.

  As responsibility for cost, schedule, and technical issues will be assumed by the contractor, the Project Sponsor must be willing to invest the necessary time and effort before the contractor is procured to assure that the risk allocation and other desired outcomes are thoroughly assessed and clearly communicated. This requires not only an effective qualification and procurement process but also an internal assessment of responsibilities within the Project Sponsor organization to decide how oversight will be handled to assure desired outcomes. The Project Sponsor must monitor the use of these controls during execution of the project. The oversight controls are essentially the Project Sponsor's direction and oversight of the project.

- *Change Orders and Claims* – Factors contributing to change orders and claims include: (1) design is not totally or substantially complete at the time of construction contract award; (2) inflation, escalation of material and labor prices; and (3) other changes that occur during the time required to perform all construction work. Because design is the responsibility of the D/B or D/B/O/M contractor, it is difficult to justify a construction claim for its own inability to coordinate design and construction sequencing. Changes in work should only occur at the direction of the Project Sponsor, necessitating a justifiable change order – otherwise the frequency of claims should be minimal under alternative project delivery method procurement approaches. Single and multiple prime contractors generally abide by the dictates of the A&E and Project Sponsor's drawings; thus, if unforeseen conditions are encountered (rapid inflation, labor unrest, geotechnical, hazardous materials) it may be the Project Sponsor's responsibility to pay for the changes.

3.7 Quality Assurance/Quality Control

3.7.1 FTA Quality Assurance/Quality Control Guidelines Summary

QA refers to all controlling bases (i.e., codes, regulations, law, agreements contracts, etc.) and accepted best practices and the activities necessary to verify, audit, and evaluate the quality of deliverables and outcomes. QA involves establishment of a quality program for the project or, if desired, individual programs for organizations such as the engineering department, construction department, etc. Within this program, a plan describing the organization(s) for QA and QA polices and authorities must be prepared, together with Quality Control procedures with roles and responsibilities.

Guidance for establishing a QA/QC program and plan can be found in:

☞ Quality Assurance and Quality Control Guidelines, by searching the DOT Bureau of Transportation Statistics website [Ref. 2-57]

While the size of the QA staff will vary depending on project size, personnel throughout the project organization will have QC responsibilities as specified in the QC procedures. For example, the QA policies should specify that there be design reviews, which will involve many participants from many disciplines. The QA program ensures that QC procedures are established, documented, and followed.

A QA program will provide an effective system for ensuring that:

- All work is performed in accordance with engineering requirements.
- All work adheres to approved design criteria as well as applicable laws, regulations, codes and industry best practices. Further, it will conform to published, though not necessarily binding, recommendations from industry groups relevant to the designed feature or equipment.
- All construction is performed in accordance with the design intent, whether originally in the contract or altered through an approved change request or owner directive. Construction oversight will be provided as approved by the owner, and may vary by project being provided by owner staff, though construction manager consultants, or possibly even the contractor under alternative delivery methods. In this later case, the Project Sponsor must still be in the position of having complete authority for final acceptance.
- All equipment is tested throughout development, manufacture, and installation to verify that it will function as specified.
- Undesirable conditions are detected early and positive corrective action is taken in a timely manner.

- Control over the system hardware configuration is maintained at all times to define the acceptability of equipment (as established by design reviews, drawing approvals, and design verification testing), to control configuration during retrofits and modification work, and to ensure that the system will be safe for public use.

3.7.2 Project Quality Assurance/Quality Control Requirements

Project QA/QC guidelines describe fifteen elements of an effective quality program. These elements are:

(1) *Management responsibility* - The Project Sponsor should define and document a quality policy and should communicate, implement, and maintain that policy at all levels of its organization. Management should designate a representative with defined authority and responsibility for ensuring that the quality policy is implemented and maintained. Management should also identify staff responsible for the quality assurance function and should define in writing the responsibility, authority, and interrelation of those persons.

(2) *Documented quality system* - The Project Sponsor should establish and maintain a documented quality system to ensure quality objectives are satisfied. The quality system's requirements should extend to the Project Sponsor's suppliers and contractors as appropriate.

(3) *Design control* - The designer should establish and maintain procedures to control and verify the design of the transit systems to ensure that the design criteria and all other specified requirements, including those of relevant regulatory agencies, are met. Design control includes ensuring that the design requirements are understood, planning the design interfaces and design verification activities, executing the design verification activities, and controlling design changes through project completion.

(4) *Document control* - Procedures for control of project documents and data should be established and maintained. The document control measures should ensure that all relevant documents are current and available to all who require them. This helps ensure that future procurement of replacement equipment or components will meet the original product requirements. A useful tool for tracking project documents is the design output index, which lists every document developed for the execution of the project. The design output index should contain a listing of the latest revisions of the following: Drawings, technical specifications, special processes, test specifications, and engineering change notices.

(5) *Purchasing* - The purchaser should ensure that the purchased service or product conforms to the purchaser's specified requirements. The purchaser should require supplier quality programs appropriate to the work being performed.

(6) *Product identification and traceability* - Measures should be established and maintained to identify and control items of production (batch, materials, parts, and components) to prevent the use of incorrect or defective items and to ensure that only correct and acceptable items are used or installed.

(7) *Process control* - Suppliers and contractors should identify and plan the production and installation processes that directly affect quality and should ensure that these processes are performed under controlled conditions. Special processes, the results of which cannot be verified by subsequent inspection and testing of the product, should be continuously monitored.

(8) *Inspection and testing* - Inspection and testing procedures should be planned and executed as necessary to verify quality. Procedures should be specified and implemented and the results documented for receiving incoming product, for work in process, and for final inspection and testing.

(9) *Inspection, measuring, and test equipment* - Equipment required to carry out inspection and testing should be identified, controlled, calibrated, and maintained in order to demonstrate the conformance of work to the specified requirements. Provisions should be made for recalibration of such equipment in a timely manner.

(10) *Inspection and test status* - A means should be provided for identifying the inspection and test status of work during production and installation. The purpose of this is to ensure that only work which has passed the required inspections and tests is accepted.

(11) *Nonconformance* - Procedures should be established and maintained to control nonconforming work in order to ensure that such work is not used or installed inadvertently.

(12) *Corrective action* - Corrective action procedures should be established, documented, and maintained. These include procedures for investigation of the cause of nonconforming work and the corrective action needed to prevent recurrence, and procedures for analysis to detect and eliminate potential causes of nonconforming work. This also includes implementing and recording changes in procedures resulting from corrective action.

(13) *Quality records* - Procedures should be established and maintained for quality records. These procedures should identify which records should be kept and assign responsibility for production and collection, indexing, filing, storage, maintenance, and disposition of quality records.

(14) *Quality audits* - An internal audit should be established to ensure that the elements of the quality system are functioning as intended.

(15) *Training* - The Project Sponsor should establish and maintain procedures for identifying the training needs and provide for the training of all personnel performing activities affecting quality.

One objective of a QA program and robust QC procedures is to ensure that stringent intradisciplinary and interdisciplinary reviews are made of all drawings and related specifications, catching location, dimensional and functional discrepancies within and between disciplines.

Another objective of a good QA program is to prevent errors from occurring or to find errors quickly after they have occurred. This becomes more important when a product is expensive, complex, or has a long lead time. In such cases, an inspection and testing program can be employed to monitor work in progress.

Inspections and tests should ensure that contractor workmanship complies with requirements and conforms to industry standards, the configuration of the item conforms to the latest approved documents, and/or deviations are identified, that the item conforms to functional requirements, and that the contractor's documentation verifying acceptability is complete and adequate. To ensure that all work performed complies with requirements, hold points for owner inspection and authority to proceed should be established throughout the process of procurement, manufacture, and testing. Resident or nonresident inspectors should be assigned to conduct inspections or witness tests, and a system of documentation should be employed to record data relative to the inspections and the findings.

The requirements should be defined by the specifications, contract drawings, approved contractor drawings, referenced standards, and related owner-approved documentation. Workmanship should be assessed in terms of the specifications and referenced standards, or, if allowed in contract documents, approved contractor's work quality standards.

A thorough review of the contractor's inspection and test records for the work being inspected is a key element in the inspection. The records should demonstrate the contractor's QA verification of the acceptability of the equipment or work presented and the satisfactory completion of all appropriate prerequisites. The owner can reduce the need to conduct detailed inspections of the contractor's work by rigid enforcement of the requirement for the contractor to have an effective QA program.

FTA requires pre-award and post-delivery audits for buses and rail vehicles. Such items clearly deserve work-in-process inspections because they are expensive, complex, and have long lead times. Guidance for meeting this requirement can be found in:

- ☞ Pre-Award and Post-Delivery Audits for Rolling Stock Purchases*, 49 CFR 663* [Ref. 3-34]

3.7.3 Alternative Organizational Structures

QA/QC on Transit Projects

The grantee and its contractors must realize the importance of a structured, adequately staffed and experienced QA/QC organization that will document the status of the work and its compliance with the contract requirements and provide objective and timely reporting on the results of inspections. Regardless of the project delivery process used, but especially when using D/B project delivery, grantees must develop a strong QA/QC program that vertically integrates all requisite checks and balances. The QA/QC program must be adequately staffed in both numbers of personnel and qualifications. QA/QC activity must be accomplished without bias to cost or schedule, in a timely manner, and consistent with completing the work and performing the work adequately the first time, which will lead to a safe, certifiably reliable operating system constructed with the quality expected of a traditionally delivered project.

The appropriate organizational relationship of the QA/QC functions will be directly related to the overall project development and contract packaging approach and allocation of responsibilities between the Project Sponsor and contractor(s). Typically, QC responsibility is given to the contractor, while the Project Sponsor, who may be assisted by the services of a construction manager, maintains QA responsibility. In D/B or turnkey projects, the contractor may also be given QA responsibility, but, as a minimum, the Project Sponsor must maintain a quality oversight role. Often there is a requirement that the D/B contractor include a third-party quality assurance entity that is agreeable to both parties.

In any implementation approach, the QA and QC functions must be organizationally independent of those actually responsible for performing the work. This enables potential quality problems to be identified and resolved without being subject to the day-to-day cost and schedule pressures of those directly responsible for project implementation.

3.7.4 Total Quality Management/International Organization for Standardization

Concepts of total quality management (TQM) can be effective in creating an environment for continuous improvement of the processes of transit system Project Sponsor, consultant, and contractor organizations. TQM can also be applied to a project by instigating frequent reviews involving all participants, through communications, and by modification of approaches, and training to facilitate changes. Partnering and a lessons-learned program can reinforce a project TQM program.

The International Organization for Standardization (ISO) has established quality process standards. Manufacturing, construction, and consulting organizations can improve their quality processes and performance by adhering to these standards and becoming certified. Agencies may selectively establish ISO quality certification requirements for contractors used for certain critical (e.g., safety or reliability) functions, provided the requirement does not limit competition.

3.8 ADA Compliance

A Project Sponsor, as a recipient of FTA financial assistance, is required to carry out provisions of the Americans with Disabilities Act (ADA) of 1990, Section 504 of the Rehabilitation Act of 1973, as amended, and the DOT's implementing regulations at 49 CFR Parts 27, 37, 38, and 39 and the guidance given in FTA Circular 4710.1. These regulations require reasonable modifications to policies, practices, and procedures to avoid discrimination and ensure accessibility to individuals with disabilities.

FTA reviews a Project Sponsor's conformance with ADA regulations during the grant-making process or as part of compliance review in the course of program oversight. Accordingly, FTA may request of the Project Sponsor project modifications or changes in policy, practice, or procedure. FTA typically leverages existing review processes to track the Project Sponsor's conformance with ADA requirements and reasonable modification requests.

The DOT ADA regulations at section 37.41(b)(1) describe limited exceptions to the DOT standard, and detail how compliance still is required to the extent that it is not structurally impracticable. FTA may require documentation substantiating any claim that compliance with a particular DOT standard is impracticable.

Where compliance is impracticable, the Project Sponsor must adhere to principals of equivalent facilitation outlined in 49 CFR Part 38.2, which indicates that departures from particular technical scoping requirements are permitted where the alternative design and technologies used provide substantially equivalent or greater access to and usability of the vehicles or facilities. FTA considers these departures on a case-by-case basis.

Table 3-11 lists notable ADA compliance requirements for construction projects posted as of October 2015 at the FTA website. The listing treats new construction, facility alterations or additions, commuter rail projects, BRT systems, light rail projects, and remanufactured or rebuilt vehicles.

Table 3-11. Notable ADA Compliance Requirements for Construction Projects

New Construction of Facilities

- Sixty percent of all public entrances to the facility must be accessible. If there are only two entrances, both must be accessible. (DOT ADA Standard 206.4.1.)
- For rail projects, no flange way gap can be greater than 2.5 feet where passenger circulation paths cross tracks at grade. (DOT ADA Standard 810.10.)
- Accessible routes that coincide with, or are located in the same area, as general circulation paths and elements such as ramps, elevators, and fare vending and collection must be placed so as to minimize the distance that wheelchair users and other persons who cannot climb steps must travel in comparison to the general public. (DOT ADA Standard 206.3.)
- Curb ramps must have detectable warnings. (DOT ADA Standard 406.8.)
- Bus boarding and alighting areas must be in compliance with the ADA-ABA Guidelines (Section 810.2), which address surfaces (sturdy), dimensions (96" long x 60" wide); connection to sidewalks, streets and pedestrian paths; slope (not steeper than 1:48); signs; and public address systems. (DOT ADA Standard 810.2.)
- Station platforms must be coordinated with the vehicle floor height. (DOT ADA Standard 810.5.3

Alterations or Additions to Facilities

- Altered or added portions of the facility must be made accessible. (DOT ADA Standard 201 and DOT ADA Regulation 49 CFR 37.43(a)(1).)
- The path of travel to the altered or added portion of the facility must be made accessible, to the maximum extent feasible. (DOT ADA Regulation 49 CFR 37.43(a)(2) and DOT ADA Standard 202.3.)
- If the path of travel cannot be made accessible, the Project Sponsor must submit to FTA an analysis demonstrating that the cost of making the path of travel accessible is disproportionate to greater than 20 percent) the cost of the alterations or additions to the primary function area. (DOT ADA Standard 202.4 and DOT ADA Regulation 49 CFR 37.43(e)(1).)
- If the path of travel cannot be made accessible, the Project Sponsor must submit to FTA an analysis demonstrating that site-specific conditions prevent making the path of travel accessible. Include relevant diagrams and maps. (DOT ADA Standard 202.4 and DOT ADA Regulation 49 CFR 37.43(b).)

Commuter Rail Projects

- Wheelchair users must have access to all accessible cars available to passengers without disabilities in each train using the station. (DOT ADA Regulation 49 CFR 37.42.)

Bus Rapid Transit (BRT) Systems

- ADA standards apply to buses and bus boarding and alighting areas as well as BRT vehicles and stops/stations. (DOT ADA Regulation 49 CFR Part 38, Subpart B and DOT ADA Standard 810.)
- If not using a lift or ramp to provide level boarding, the Project Sponsor must submit to FTA a demonstration of equivalent facilitation. (DOT ADA Regulation 49 CFR 37.7(b) and DOT ADA Regulation 49 CFR 38.2.)
- If roadways are being resurfaced or otherwise altered as part of a BRT project, curb ramps must be installed at crosswalks that have been affected. (DOT ADA Standard 106.5.)

Light Rail Projects

- Complimentary paratransit service must be provided for fixed-route systems. (DOT ADA Regulation 49 CFR Part 37, Subpart F.)

Remanufactured or Rebuilt Vehicles

- Remanufactured or rebuilt vehicles must be accessible. (DOT ADA Regulation 49 CFR 37.75; DOT ADA Regulation 49 CFR 37.83; and DOT ADA Regulation 49 CFR 37.89.)
- If a remanufactured or rebuilt vehicle will not be accessible, the Project Sponsor must submit information to FTA demonstrating that the structural integrity of the vehicle would be significantly compromised if it is made accessible. Include an appropriate structural engineering analysis. (DOT ADA Regulation 49 CFR 37.75 (c); DOT ADA Regulation 49 CFR 37.83(c) and DOT ADA Regulation 49 CFR 37.89(c).)

FTA's ADA guidance Circular 4710.1, referenced in Chapter 2, provides an optional facilities checklist for design and construction of new or altered transportation facilities.

3.9 Communications

Project management, to be truly effective, requires open and continuous communications and dialogue at all levels and during all phases of a project. The complexity of any transportation project requires the development of a strong communication network within the project and with the agencies funding the project, other key stakeholders and the public. A strong internal communications network provides for open lines of communication among all participants and across all project functions. Section 3.2.2 addressed the need to have all affected groups represented on the project team directly or through advisory committees. Strong communication and coordination internally through standardized project organizational reporting requirements and the establishment of a central reporting office will ease the way for the external information flow necessary for the public's participation.

An effective communications program requires that all information provided – to ALL parties – is accurate, timely, and relevant. A project communication program must be developed to ensure that the right information is getting to the right people.

An effective communications program and strategy for its implementation must support all project functions (e.g., management control, Real Estate, design, construction, and operations, where they already exist). Policies and procedures should be established for reporting project progress (necessary for project oversight as well as grant reporting) and determining schedules for periodic meetings and reports. Other steps within the communications program include determining critical program interfaces, identifying affected audience, designating staff responsible for all information flow, and establishing a public information and public participation program. To ensure that community input and feedback are received on a project, support for a public information and involvement program should be included in the contract requirements.

Communications programs must target project partners and stakeholders as well as the communities affected by the project. These relationships may be governed by agreements, memoranda of understanding, or formal requirements associated with funding or environmental impact commitments. Maintaining regular communications will support effective project delivery by minimizing disputes that could disrupt and delay the project.

3.9.1 Project Coordination

It is important to establish the major interfaces within a project structure where coordination is critical to a project's performance. These interfaces exist between the companies under contract, functional units, project locations, project phases, project and governmental regulatory agencies, and private and other public interests. Formalizing written project coordination means and methods enables the members of the project organization to work together more efficiently.

To enhance interface management, the following should be clearly defined:

- Responsibility of each agency, department and team member
- Authority, and accountability related to each of the above
- The interfaces between various project functions
- Inputs and outputs in terms of content, schedule and project status
- Lines and procedures for communications to facilitate informed and synchronized decisions.

Procedures for communications within the entire project organization should include authorizations, reports, schedules, meetings, and reviews supported by documentation (i.e., records management). Procedures for communications with external entities should include public information, responsibilities for obtaining permits and licenses, and reporting requirements imposed by contracts, grants, regulations, and other legal requirements.

3.9.2 Audience

It is important to identify the audiences that will interface with a project; these may include:

- The governing bodies (boards, commissions, or districts)
- Local governments (city and county levels)
- State government (departments, agencies, and legislative bodies, if appropriate)
- Federal agencies (Department of Transportation, Department of Interior, Department of Defense, General Services Administration, Department of Homeland Security, and Congress, if appropriate)
- Utilities and railroads
- Public (individuals, civic associations, citizen groups, business associations)
- Existing transit system users (riders and operating employees)
- Internal project staff (management, supervisory, and employee groups)
- Emergency responders (fire, police, paramedic, area hospitals)
- Schools in the project's immediate area or that might be affected by changes in traffic patterns
- Media (press, radio, TV, Internet)
- Workers on the project

3.9.3 Program Responsibility

The credibility of the Project Sponsor for a transit project depends upon accurate information provided in a quick, responsive, and consistent format suitable for various audiences. To obtain this, it is essential that a single source be established for that information -- generally an individual or office designated as “project information" that should be able to disseminate all information regarding the project. Such an office would include a spokesperson to convey information to all audiences, an information officer to act as a clearinghouse for the flow of information to and from the public and media, and, if a multitude of government agencies and government levels are involved, a government liaison or office.

3.9.4 Transit Riders

In addition to maintaining the safety and security of the existing transit system and adjacent public facilities, the ease of access to and use of the transit system must be maintained. Whenever a project involves the modification or expansion of an existing transit system, there must be a process for considering the needs of transit riders and the general public. Newsletters, flyers, news media announcements, emails, and signage are effective methods of alerting transit riders of project impacts.

Communication with the public can be crucial for receiving the buy-in necessary to move a project forward. Transit riders should not only be informed of what is or will occur, but should be invited to express their ideas and concerns. The format for this should be such that they know that their ideas are being heard, and that their concerns are valued and actively addressed fairly. Transparency and reaching out to constituents will help mitigate political, cultural, and other potential barriers to the acceptance of the project.

CHAPTER 4 – MANAGING THE PROJECT DURING THE ENGINEERING DESIGN PHASE

4.1 Introduction

This chapter discusses the Engineering Phase. It expands on Chapter 2's description of the project development process and its major inputs, processes, and outputs, including the following project development topics that are related to this chapter:

- Systems planning
- Alternatives analysis
- Project Management Plan requirements
- Rail modernization planning
- Bus maintenance facility planning
- Project risk analysis and procurement planning
- Environmental planning
- Financial planning
- Joint development planning
- Safety and Security Management Plan requirements

In a Major Capital Project (MCP), Engineering is initiated after completion of the NEPA process and sufficient design has occurred according to FTA guidelines. It follows PD and includes all design prior to procurement and. During Engineering, the Project Sponsor is expected to prepare the drawings, specifications, and bid documents required for awarding facility construction, equipment fabrication, and installation contracts. An alternative project delivery method will combine some level of design and construction into a single contract.

Chapter 3 defined management principles and practices that apply to more than one phase of the project development process, including:

- Project and Management Organization
- Cost Estimation and Funding
- Scheduling
- Project Control
- Risk Assessment and Management
- Safety and Security Certification
- Hazard Analysis
- Threat and Vulnerability Assessment
- Procurement and Contracts
- QA and QC
- Project Communications

This chapter adds project management guidelines specifically related to the Design and Engineering of a transit capital project.

4.2 Design Team Organization/Contracts

The project's management is the responsibility of the Project Sponsor. If Project Sponsor staff is unable to provide the required services during Engineering, mistakes or omissions may affect Construction by creating schedule and budget problems. A number of approaches are available to Project Sponsors in organizing the design team with varied levels of Project Sponsor involvement.

A successful design team organization starts with an evaluation of the Project Sponsor's strengths and weaknesses, including staff experience working on or managing similar projects. If its staff lacks sufficient experience, the Project Sponsor should consider use of consultants or other professional assistance. Some successful transit projects have limited Project Sponsor staffing and involvement, relying heavily on a general engineering consultant (GEC); others do most of the engineering and construction management in-house. Another approach is to have a "program manager" structure that relies on an engineering consultant. While any of these approaches or even an approach using a mix of Project Sponsor and consultant staff can be successful, the key issue in any plan is that all design disciplines are covered and that decision-making authority between the Project Sponsor and the designer is clearly delineated, with the Project Sponsor retaining final authority over all aspects of its project.

For traditional methods, two alternatives exist for organizing the design effort. Each depends on the degree of experience and size of the Project Sponsor's staff. In one alternative, the Project Sponsor's staff performs all design functions; in the other, consultants perform all design functions. Between these extremes, several other arrangements are possible. For larger projects, the Project Sponsor, a GEC, or program manager may supervise and manage the work of consultants retained to design portions of the project. Selection of a GEC or program manager should be based on proven experience on similar work performed by the firm, and a commitment to assign a manager and staff qualified to provide the services required. If section designers are used, the Project Sponsor, GEC, or program manager should establish the design criteria and system specifications, as well as the initial construction schedule and cost estimate. A Project Sponsor-mandated *Project Schedule* provides the constraints under which the section designers must perform their assignments.

Continuity of engineering services during design is highly desirable. The Project Sponsor design staff should be available throughout Engineering. Splitting responsibility for phases could result in duplication of effort, lost time, and added expense. Sponsors must keep in mind that the consultant used to prepare the environmental analysis and documentation as required by NEPA should be separate from the design consultant to avoid potential conflicts of interest. If a change in consultant must be made during Engineering, time and budget must be included to provide for review and adoption and/or adaptation of the prior consultants work by the new consultant.

The involvement of transit operations during the design of a capital project can help assure its successful implementation. For a mature organization currently engaged in transit operations, the review and approval of design decisions by operations will minimize problems and permit safe and smooth integration of the improvement with existing operations. For new systems, sufficient expertise should be available to perform these review functions by both consultants and the Project Sponsor personnel who will be responsible for construction and operations.

A&E consultants should be hired only after careful evaluation of their submitted qualifications and proposals. Usually, a “short list” of three to five of the most qualified firms is designated and a selection made after discussions with the firms. This must be accomplished in accordance with the Brooks Act , which, in addition to providing guidance on minimum acquisition procedures, also mandates that design contracts be awarded based on demonstrated competence and qualifications for the type of professional services required, and not based on low price. Price may certainly be a consideration in selecting an A/E firm (or team of firms), but this can occur only after ranking the qualified firms and in the negotiation stage. If cost becomes a fundamental issue during negotiations, the Project Sponsor can break off negotiations and move on to the next most qualified firm/team.

4.3 Construction Procurement Considerations

The Project Sponsor should select the project delivery method and general procurement and contracting approaches as early as possible, with attention to the procurement planning discussion in Chapter 2 and the management principles described in Chapter 3 and Appendix E. The selected procurement approach should be refined and contract documentation prepared in a timely manner to permit project implementation as scheduled. It is particularly important that, if alternative delivery approaches are being considered, these decisions occur as early as possible so that the entire process is coordinated and that the design approach is consistent with the delivery method.

The authority for procurement resides in the legislatively mandated policies and procedures of the state (and locality) in which the transit project is to be built. Where FTA funding is being used, the Federal Acquisition Regulations (FAR) will also apply. The Project Sponsor must understand its state’s procurement and contract laws prior to determining its procurement approach, whether traditional, i.e., D/B/B, or alternative project delivery method, e.g., D/B. In some instances, local laws or regulations may also control the manner in which construction contracts are developed.

At a minimum, the D/B/B delivery method requires the efforts of a Project Sponsor, a separate design entity, and one or more construction contractors. The Project Sponsor may also rely on the services of a General Engineering Consultant (GEC) or program manager. The Project Sponsor selects a designer to develop and design the project and produce sealed drawings and specifications. These are packaged into bid documents that define the work and the terms and conditions for which contractors submit bids. The Project Sponsor awards the contract to the lowest responsive and responsible bidder. Contracts that are bid at a fixed price usually offer the most competitive pricing climate.

The traditional delivery method is intended to give the Project Sponsor control over the design and create a partnership with the designer to monitor construction contractors.

This situation, however, has sometimes resulted in an adversarial relationship between the designer and the construction contractors over issues of interpretation. It is the Project Sponsor's responsibility to have an organization and contractual framework in place to mitigate any potential risks and, ultimately, to ensure that the project is completed within budget and on time. An option selected by many Project Sponsors is to use a separate construction management (CM) consultant whose responsibilities would include expediting construction and resolving design disputes or issues of interpretation.

Compared to D/B/B, each of the alternative project delivery methods presents different aspects and allocations of risks between the Project Sponsor and the contractors. The contract provisions become the mechanism for assigning the risks and defining each entity's responsibilities. These provisions must be included as part of the procurement packages, which will have different timeframes depending on whether the contractor is given both design and construction responsibilities. The procurement packages for alternative delivery projects are likely to require the development of substantial procurement documentation as discussed in Section 2.2.6.

4.3.1 Construction Contract Bid Documents and Requirements

For traditional D/B/B, construction contract planning is conducted during Engineering, when the Project Sponsor sets in motion essential processes – so that when design is completed and construction is to commence, the known elements of risk, hazard, and vulnerabilities are acknowledged and responsibilities are assigned to the parties considered best able to minimize them. Contract planning should be done in accordance with the Project Sponsor's objectives for the project, project-specific circumstances, and identified risks, hazards, and vulnerabilities. Contract planning should result in inclusion in the contract specifications and the terms and conditions that will act to guide both the Project Sponsor and the selected contractor(s).

The Project Sponsor must decide on the numbers and types of contracts required to implement the project. A range of options is available, from single to multiple prime contractors with as many as hundreds of separate contracts, and from traditional to the many alternative contracting methods. Generally, large agencies with experienced staff use multiple prime contractors. Construction contract pricing alternatives are then explored -- the most typical being lump sum, unit price (based on lowest bid), or a combination of such payment methods. Other methods include cost plus fixed fee, guaranteed maximum price, and lump sum plus special reimbursable costs.

While the essential focus of all procurement approaches is to assure that a quality project is delivered on a timely basis, there can be considerable variation when using alternative delivery approaches. While some may regard it as complex, and time-consuming, the traditional procurement approach presents no unusual challenges, and is well understood by those involved.

The Project Sponsor should have a Source Selection Plan (SSP) or at the least, an Acquisition Plan (AP) prepared to guide and monitor its process. Generally, a complex negotiated acquisition that will take a long time to complete has an SSP, while an AP may suffice for a simplified, sealed-bid or smaller dollar acquisition. In either case, the Project Sponsor should document the following elements:

- Acquisition method, including the contract requirement, expected competition, and method or procurement
- Source selection organization, including the recommended members identified by name, position title, or functional area
- Pre-Solicitation activities, including market research and synopsis
- Evaluation procedures, including whether award will be made based on the identified low-priced technically acceptable offer or a trade-off evaluation
- Evaluation factors and their relative importance, including
    - Price or cost
    - Technical
    - Management; and
    - Past performance
- Schedule of events, including key events and the projected dates for completion Key events should include such activities as:
    - Issuing the solicitation
    - Receiving offers
    - Completing offer evaluation
    - Source Selection Authority (SSA) decision
    - Contract preparation and signature
    - Contract approval
    - Contract award

Generally, Project Sponsors have relied on four primary procurement approaches to implement MCPs:

- *Formally Advertised (Invitation for Bids)* – Provides detailed design drawings and specifications and is awarded to the responsible and responsive bidder with the lowest bid. These contracts may be paid on a unit price basis, as a fixed price contract, or a combination of payment provisions.

- *Competitive Negotiations (Request for Proposal)* – Provides performance specifications with evaluation of initial proposals to determine competitive pricing. Although selection can be based on the initial price submitted, most often discussions ensue with each proposer to assure understanding of terms and conditions, followed by Best and Final Offer (BAFO) prior to award of contract.

- *Qualification-Based Competitive Negotiations (or "Two-Step") (Request for Proposal)* – Provides performance specifications for proposals – strongly emphasizing qualifications but precluding submission of prices, followed by the establishment of a short-list of the most qualified proposers. Discussions are held with short-listed proposers prior to selection of the best-qualified entity, upon which negotiations are held for a contract, including a fair and reasonable price.
- *Best-Value (Request for Proposal)* - Almost all best-value evaluations are based on a 2-step process where initially a Request for Qualifications is issued and a short-list established. Then a Request for Proposal package is issued to the short-

listed firms/teams. When the detailed proposals are submitted, they are evaluated based on the listed criteria in the RFP package, which includes price. This process may or may not include a BAFO process.

Variations in these procurement approaches offer hybrid approaches; these are reviewed in the following sub-sections.

4.3.1.1 *Consideration of Formally Advertised Contract Procurement*

The primary difference in the Invitation for Bids process between traditional and alternative procurements is the size and/or scope of the project, and the way in which risks are shared. The outcome of a larger, less defined project is an increased likelihood of more change orders after the contract is awarded, possibly leading to project schedule delays and cost overruns. To compensate for this and to assure that the awarded low-price contract is not compromised due to numerous change orders, the bid process should require as much pricing detail as possible and would be aided by incorporating unit pricing into the contract language.

4.3.1.2 *Non-Traditional Procurement Methods*

For alternative contracts, the method of procurement and the construction contract bid documents will vary depending on what the state or local statutes permit. It is vital to know whether state or local statutes permit a Project Sponsor to combine design and construction or allow pre-qualification processes, or to allow negotiations by requiring that the basis of the award be Low-Price. Approaches with such prohibitions limit the Project Sponsor’s ability to determine the qualification of the bidder, as bidder comments are absent or unclear, bidder “wishes,” “cost-drivers,” or “deal-breakers” are not always discernible, and contract changes are offered to all bidders, even perhaps offering unnecessary concessions. Procurement processes that allow for negotiations, however, can result in the “best deal” for the “best price.” It is a process that can result in a true “meeting of the minds.” The absence of contract negotiations before bidding or the BAFO can lead to decision-making without that kind of communication.

A two-step bid process may be an ideal choice for many contracts because it can facilitate fuller consideration of contractor qualifications for the specific work being advertised. If allowable, negotiating such a non-traditional construction contract may be a better procurement method because it allows the Project Sponsor to more closely examine the capabilities of contractors and to solicit industry ideas and techniques for designing and building the project prior to the Project Sponsor committing to a contractor selection. Solutions to concerns indicated by the potential contractor(s) can then be crafted to achieve optimum balance between risk and price, and the contractor can develop a better understanding of the Project Sponsor and its intentions. Overall, negotiations may lead to better decisions and allow the Project Sponsor to select the contractor with the best approach, as well as consider other factors including price, experience, and qualifications.

4.3.1.3 *Pre-Qualification*

The 1996 Federal Acquisition Reform Act (FARA), which was the first significant modification in Federal procurement of A&E services since the Brooks Act permitted Federal agencies broader authority to pre-qualify or short-list eligible proposers under a “two-step” procurement process. A pre-qualification process narrows the list of bidders allowed, which provides advantages for negotiated procurement, such as identifying contractors with a proven record of performance.

The objective of pre-qualification is to learn as much about the potential bidders as possible prior to entering the procurement phase. There is, however, the perception that the pre-qualification process can be misused and restrict the opportunity of small, new, and disadvantaged firms to participate in the procurement process.

So long as the process is fair and competitive – where an established objective exists to allow sufficient participation by a number of firms – pre-qualification can help achieve Project Sponsor goals. This process is consistent with the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments, 49 CFR 18 [Ref. 2-48], which indicates that Project Sponsors and sub-sponsors must ensure that all prequalified lists of persons, firms, or products which are used in acquiring goods and services are current and include enough qualified sources to ensure maximum full and open competition. To minimize the opportunity for “bid shopping” of DBE firms, FTA policy requires that all DBE firms be identified at the time of proposal and that no substitutions be allowed without prior approval. DBE incentive/disincentive clauses tied to meeting DBE participation goals are also an option. One example is to impose liquidated damages if the DBE goal is not achieved.

4.3.1.4 *Issues and Opportunities for Industry Reviews in Contract Procurement*

Generally, industry reviews should be conducted from as early as PD and through Engineering. Reviews are particularly important when alternative delivery procurements are being considered to address inherent uncertainties and complexities in the project. Once design has progressed and the project delivery method selected, industry reviews provide opportunities for contractors to submit comments and provide insights not always available during the traditional (D/B/B) procurement cycle. This is an important process in non-traditional procurements, since it addresses questions and concerns regarding financing, level of engineering, risk management, hazard and threat management, and project management roles and responsibilities. In addition to obtaining written comments, discussion of comments in scheduled meetings with the individual contractor is found to be very beneficial.

Due to the size and complexity of procurements involving design and possibly O&M and/or financing in addition to construction, it is imperative that issues and/or problems in the contracting approach and conditions be identified early and addressed before the procurement cycle begins. It is advantageous for the Project Sponsor to solicit and accommodate industry comments for all project contracting, where feasible, in order to modify the solicitation package before the procurement cycle begins.

4.3.2 Subcontracting and the Utilization of Small and Disadvantaged Firms

A number of Federal and local laws relating to the provision for, and compliance with, labor and equal opportunities provisions are relevant to both traditional and non-traditional contracting. Third-party subcontracting issues – especially incorporating small business enterprises (SBEs) and disadvantaged business enterprises (DBEs, both minority and women-owned) must be addressed by public agencies. The goal should be to provide an atmosphere where conditions for maximum opportunity and encouragement to participate exist.

A perception exists that alternative project delivery methods have the potential to reduce the opportunity for small, mid-sized, and DBE firms, because the number of prime contractors are reduced. For many MCPs using non-traditional procurement methods, large teams may be required to perform construction, in addition to other functions such as design, O&M, financing, and joint development. As a result, smaller firms could be "squeezed out"' or relegated to less visible roles, without direct client interaction. The concern is that these firms may not be afforded opportunities for leadership roles in proposal preparation or project execution, thus reducing their chances to develop the experience to grow and contribute more meaningfully to the next project.

4.3.2.1 *Utilization of and Compliance Assurances Relative to Small and Disadvantaged Businesses*

Project Sponsors should avail themselves of existing registers of Small and Disadvantaged Business Enterprises, or S/DBEs. Such registers typically exist with state departments of transportation or similar local governmental agencies. FTA's Office of Civil Rights also is a source of such lists, either as developed by it or through referral.

Project Sponsors may also enhance the potential pool of S/DBE candidate firms by undertaking "availability analyses" whereby research in local area will identify such firms that are doing business across the local market place and the types of contracting work they are qualified and financially able to bid upon. With such identification, a Project Sponsor can be pro-active and provide its own or augmented list of S/DBE firms for potential bidders as well as utilize their research to establish reasoned S/DBE participation goals that best reflect the type of work contained in each construction or equipment/materials contract. Further, with this more robust knowledge of the market place, Project Sponsors can assist the S/DBEs. The issue of commitment or attainment of S/DBE inclusion is due to the firm position on the part of the elected official of that particular community, as well as transit board members and staff, to expand opportunities through assertive efforts towards recruitment, certification, and monitoring compliance.
Major shortcomings and challenges are still present in transit procurement with regard to accomplishing S/DBE goals stated in the contract, requiring clarification of what counts as a DBE – especially relating to second and third tier subcontractors – and finally, monitoring and recording the compliance.

Issues have also been raised that stem from predatory business practices and abuses by prime contractors as they relate to subcontractor substitutions or "sub-busting," "fronting," "bid-shopping," release of retention, "striker replacement" tactics, and "slow or no pay."

To assure DBE compliance, some Project Sponsors have stringent Liquidated Damages clauses for failure to comply. Sponsors should require prime contractors to provide names of proposed SBE and DBE firms prior to bidding, along with required subcontract documentation. In addition, a Project Sponsor might address the cash-flow management issue for small businesses by increasing its payment schedule to twice a month. Incorporating strong “make or buy” clauses based on incentives and disincentives in the contract can also greatly reduce “bid shopping.”

4.4 Design Criteria and Standards

Building on the project definition established in PD, traditional Design/Bid/Build project delivery methods require full or nearly complete development of the project’s design and operational criteria at completion of 30 percent and before entry into Engineering. This information is typically developed by subsystem (i.e., track, structures, stations, vehicles, signals, traction power, communications, yards, and shops). For expansion and/or modernization projects, the criteria may be adapted from earlier Project Sponsor projects during the Planning Phase.

The remainder of this section provides a list of tasks that should be accomplished to reach a 30 percent design by the end of the PD Phase.

4.4.1 Establishment of Operating Performance and Facilities Requirements

4.4.1.1 *Perform Surveys*

This task includes surveys that may be required to investigate alternative configurations and construction methods properly:

- Control surveys
- Aerial and surface topography surveys and planimetrics
- Acquisition of data from as-built plans of previous and adjacent (to the project site) improvements, including those of utilities
- Subsurface geologic/seismic exploration
  - Compilation and review of geology data from city and state agencies
  - Subsurface test borings and seismic tests, as necessary
  - Interpretation of boring logs and development of geotechnical report
  - Development of segment design criteria based on geologic/seismic tests
  - Building foundation inventory
- Data acquisition from as-built plans of previous and adjacent site improvements
- Major utility surveys
- Identification of utilities to be relocated and cost estimates for relocation
- Initial description of the project’s approach to safety and security analysis
- Condition assessments and cost estimates for adapted or reused facilities
- Environmental site assessments
- Noise and vibration baseline assessments
- Stray current and EMI studies, as necessary
- Other surveys, as required

4.4.1.2 *Conduct System Studies*

In traditional approaches, the criteria for all subsystems should be developed after completion of all studies and evaluations. Necessary studies help to establish both system and subsystem requirements including:

- *Evaluation, through simulations, of operational and facility alternatives and their effect on transit capacity*:
  - Analysis to determine the effect of the proposed operations plan on the functional capability of the proposed project and potential future extensions of the system
  - Analysis of station spacing, station length, and train headway based on studies for patronage, development, and system operating speed
  - Analysis of effect of incremental development of automatic train operations (ATO) vs. initial full utilization
  - Analysis to determine the effect of alternative modes of operation such as coasting, lower acceleration, etc., on transit performance and vehicle life
  - Analysis to determine substation number, capacity, and location
- *Energy evaluation* – Should include an analysis, sufficiently detailed, to demonstrate the energy consumption and cost impacts of the options selected for line, profile, and stations, and to investigate the benefits of regenerative braking.
- *Travel demand* – By station for 10- and 20-year horizon and determination of the effect of patronage volumes on the initial station sizing.
- *Determination of required vehicle size and train consist* – Study based on an in-depth review of vehicle types available considering: patronage volumes, service policy, safety, security, operating environment, reliability, maintainability, costs, availability, and influence on structure costs.
- *Noise/vibration study* – To determine noise/vibration mitigation measures necessary to meet the meet environmental requirements.
- *Operable segments* – To determine the effects of constructing the proposed system in operable segments, considering the entire system as the largest segment.
- *Evaluation of fare policies and collection systems* – To include consideration of how the selected policies/systems may affect the safety and security of the system and patrons.
- *Safety and security* – Study to determine the Safety and Security Certification requirements that must be met to deliver final certification that the project is safe

Environmental Construction Issues

Environmental Site Assessments (ESA) are pre-construction investigative programs that identify soil, groundwater, surface water, or building contamination that is present on the site where construction will occur. Discovery of hazardous materials at a site during construction can prove costly in terms of removal activities and delays. They should be identified early in the project development process to assure proper mitigation measures.

and secure for passengers, employees, public safety personnel, and the general public, including individual certificates issued for specific elements to be verified.

- *Hazard analyses to support safety requirements*- to include the determination of whether the capacity to conduct professional analyses exists within the Project Sponsor's organization or whether outside consultants will be assigned these tasks
- *Threat and vulnerability assessments* – To support security requirements, including the determination of whether the capacity to conduct professional analyses exists within the Project Sponsor's organization or whether outside consultants will be assigned these tasks.
- *Bus routing analysis* – to determine garage size and locations and interfacing with rail stations and operations.
- *Power supply* – To identify traction power requirements of train propulsion and operations and requisite supply and distribution system.
- *Corrosion protection requirements* – To identify materials, locations, facilities, and vehicles with vulnerability to corrosion from stray currents or other sources, and propose solutions to the problems.
- *Electromagnetic interference (EMI) mitigation requirements* – To identify sources of and mitigation treatment for extraneous electrical or electromagnetic disturbance causing or may cause electronic equipment and facilities disturbance.
- *Tunnel ventilation requirements* – to identify ventilation requirements mandated for safety and evacuation.
- *Train control alternatives including moving and fixed block systems* – To identify operational alternatives and design the optimum solution within budgetary, service and safety constraints.
- *Failure management alternatives* – To identify sources of system failures and means of avoiding or at least mitigating potential failures.
- *ADA accessibility requirements* – To meet mandated ADA design and operations guidelines and requirements, including how design decisions will affect numbers and placement of elevators, escalators, and areas of rescue assistance.

4.4.1.3 *Select Way and Structure Types*

The alignment should be developed beyond the definition developed during PD to describe all structures necessary for the project. Minor alternative alignments may be evaluated within the corridor, as required, to the degree they remain within the design parameters established during project development and as described in the NEPA documents. The following structures should be considered during the development of the alignments:

- Bridges, tunnel, cut-and-cover, open cut, embankment, surface, shared corridor, street-running, and elevated structures, as appropriate, along the corridor.
- Tunneling and major bridges with various profiles and alternative construction methods (based on preliminary geotechnical engineering data and analysis) to permit evaluation in terms of:
  - Costs
  - Feasibility of construction
  - USACE and/or USCG permit requirements

  - Schedule impact
  - Impact on community and environment
  - Station requirements and impacts on Real Estate acquisition needs
  - Safety and security

Completion of this work will lead to selection of the final profile and structure type for each portion of the line and a set of preliminary drawings and specifications that will provide a basis for preparing a refined, more detailed cost estimate. These include, but in no way are limited to:

- Alignment drawings showing plan and profile for the entire system. Drawings should define track curvature, spirals, super-elevation, speeds, stationing, coordinates, grades, vertical curve lengths, and elevations of the control alignment and any secondary alignments where they vary in relationship to the control alignment.
- Details of way structures for all variations in configuration and cross sections, as needed, to show transitions and/or problem areas. These drawings should include the location of all crossovers and pocket and lay-up tracks in coordination with operating plans. Particular construction methods should be specified for underpinning problems, non-standard elements, or where major subsurface utilities are expected.
- Preliminary improvement plans for public ways affected by the project, identifying grade crossing locations, work limits, pavement cut lines, curb lines, typical sections, sidewalks, and lane markings.
- Preliminary grading and drainage plans for transit and affected roadways, showing flow direction and anticipated locations of catch basins, culverts, storm sewers, ditches, underdrains, tie-ins to municipal storm sewers, retention basins, manholes, inlets and area drains.
- Preliminary plans and estimates for all necessary public and private utility line changes. All necessary master utility agreements should be negotiated and completed to the extent possible before completion of preliminary designs. In some cases, these agreements will not be completed until after funding is committed; however, they must be completed soon thereafter to avoid incomplete or inaccurate designs that end up increasing utility relocations and, ultimately, construction delays.
- Preliminary ROW drawings showing the extent of properties affected with a list of property takings and easements required. A real estate program plan identifying all the integral components (property mapping, ownership, appraisal scopes of work and appraisals, through completing the final acquisition and making the site ready for a construction contractor) in a detailed schedule of ROW acquisitions, temporary easements, leases, etc., and associated approvals should be prepared to adequately capture the program costs avoid or at least minimize construction contract bidding and/or construction delays.

4.4.1.4 *Develop Station Preliminary Plans*

Station design should include the development of station concepts compatible with the various plan/profile alternatives developed for way and structures. Such studies should include alternative construction techniques. Selection of station types and construction methods should be based on cost, compatibility with adjacent construction, effect on schedule, design, and construction, their impact on the community and environment, safety and security within the facilities and adjacent station-related areas (e.g., bus or auto drop-off lanes, parking lots/garages, etc.) and ADA level boarding design considerations/ requirements.

The initial design drawings and specifications should be of sufficient scope to define all station functions and elements for both the public and ancillary spaces, including equipment and materials, as appropriate. The station design process should involve the following factors and others as appropriate:

- Develop and recommend policies and obtain Project Sponsor approval for such elements as public and employee restrooms, fare collection, security, concession spaces, vertical circulation, graphics, intermodal connections, hours of operation, standardization of layout and materials, and attendant accommodations.
- Develop system-wide architectural planning and civil standards and criteria for materials, noise control, signage and graphics, lighting, CCTV, public address systems, and Fare Collection equipment placement, mechanical and electrical equipment, vertical circulation elements, and accessibility provisions. Investigate all station elements suitable for standardized design and construction.

Arts in Transit

During the period preceding design and construction of a rail rapid transit project, the affected populace is typically given the opportunity to review concepts of alignment and station location. The Project Sponsor's concerns in the functional domain of architects and engineers are stressed at public meetings. Local neighborhood interest in appearance of the finished products and landscaping of the station surroundings, however, is often overlooked, or relegated to "post-construction" efforts, when it is usually too late to meaningfully influence the project. With increased interest in adding artwork to new and existing transit systems, Arts-in-Transit (AIT) has been included in the development and evolution of the project design from the beginning in order to incorporate art that is appealing to the majority of system users. Many projects have accomplished this with outstanding success and highly favorable public reaction. However, funding for AIT may be difficult to obtain.

Another advantage of the early and direct project involvement of an AIT initiative is greater understanding by the arts community and its supporters of the safety and security issues. This understanding will often result in fewer interferences with sight lines and passageways and encourage application of artistic considerations to normal features at little or no extra cost, e.g., tree, grates, bridges and piers, fencing, etc.

- Determine requirements for station entrances and exits, intermodal interfaces, waiting areas, ancillary spaces, stairs, elevators, escalators, and ticketing facilities using patronage forecasts, operating plans, joint development potential, and design constraints. These plans should be based on the requirements detailed in the National Fire Protection Association [Ref. 4-1] and all relevant area fire codes.
- Determine specific station location and develop plans, sections, and elevations based on the selected way, plan, and profile. Determine location and space allocations of ancillary spaces appropriate for system operation and adaptable to future extensions, if appropriate. Station layouts should provide the minimum practical volume while incorporating efficient loading of trains and convenient patron usage. Develop functional parking garage and other parking facility placements and layouts where required, using commercial standards and pricing guidelines where possible.
- Develop ADA level boarding solution(s) for each station and include in the site and station drawings (plans, sections, details, and elevation views). Coordinate ADA level boarding solution(s) at stations with the vehicle design.
- Consider Principles of Crime Prevention Through Environmental Design (CPTED) and Situational Crime Prevention (SCP) early in all station and parking facility design plans to minimize later refitting to accommodate security planning
- Coordinate all station elements with those of guideway and structures and systems groups.
- Select the construction method for each station and determine how the method affects both the station design and surrounding area.
- Determine if system-wide procurements for electrical and mechanical equipment components are practical and feasible.
- Complete all utility surveys and agreements to a level that will allow station design and construction to advance without interruption.
- Prepare preliminary maintenance procedures and estimate annual maintenance costs based on total number and skills of required station maintenance personnel.
- Determine measures to minimize adverse community and environmental impacts and maximize community benefit.
- Perform PHA and TVA, and incorporate their findings in Design and Operations Criteria.
- Secure required station area design approvals.

4.4.1.5 *Develop Yard and Shop Criteria*

Before investigating specific yard and maintenance shop site locations, the Project Sponsor should define and quantify all maintenance of way (MOW), rolling stock and subsystems maintenance, operations/yard functions, and the yard and shop(s) capacity criteria. Yard and shop facilities designs should be developed to a level consistent with the PD effort. As a minimum, the following should be determined:

- Size, type and general features of the transit vehicle(s) to be used
- Number of vehicles/consists to be stored initially and in the future
- Vehicle inspection and repair cycles

- Vehicle, subsystem, and MOW maintenance functions to be performed as well as general procedures for operations and maintenance
- Number of operations and maintenance employees, crew quarters, and parking facilities required
- Requirements for special shop equipment
- Material storage to support maintenance of the operating system and equipment
- Revenue collection facility
- Vehicle test facilities and test track
- Central control location(s) (if in yard, determine size and functions)
- Location of training facilities
- Railroad sidings or facilities/equipment needed to deliver transit cars
- Yard and shop location requirements due to operating system configuration
- Safety and security of facility(s), including hazard and vulnerability reviews and plans for internal and external security systems

In the development of yard and shop plans, details, and preliminary specifications, tasks should include the evaluation of all feasible alternative sites. Alternative locations for outlying storage and maintenance yards should be evaluated based on their effect on operable segments and schedule, area requirements, operational characteristics, impact on community and environment, and the difficulty of acquiring the proposed site. Using data developed in the planning stage, alternative layouts, ROW drawings, and cost estimates should be prepared and the optimum site selected, considering availability, costs, neighborhood compatibility, security problems, and any other significant aspects.

Yard plans should include vehicle storage track layout, related MOW facilities, and major inspection and shop buildings, detailing both major functions and areas required. The need for future yard expansion should also be considered. The yard and shop design and construction process should involve the following activities, and others, as appropriate:

- Complete all utility surveys and agreements to a level that will allow design and construction to advance without interruption.
- Determine maintenance and operations activities to be performed and estimate the total number and skills of required maintenance, operations, and support personnel.
- Prepare hazard analyses and threat assessments to minimize safety and security concerns to employees and surrounding communities.
- Determine measures to minimize adverse community and environmental impacts.
- Take all appropriate steps necessary for required yard and shop area design approvals.

Upon final selection of the optimum site, sufficient level of design and engineering should continue with development of a set of plans, specifications, and estimates sufficiently detailed to provide reliable cost estimates and a method for obtaining required approvals.

4.4.1.6 *Design Criteria for Fixed Guideway System Components*

After the completion of studies to select those systems and subsystems that are determined to be appropriate for the Major Capital Project, the Project Sponsor should develop design criteria for the fixed guideway system components. Alternative systems and subsystems should be evaluated in terms of criteria that include:

- Affirmation of the Transit Capacity or required changes thereto
- Capital costs
- Labor requirements
- Revenue service O&M costs
- Safety and security requirements and costs
- Reliability, availability, maintainability, and dependability
- Complexity for implementation and operations
- Support for incremental growth
- Probable public receptivity
- Impact on environment

Selection of the design elements for the MCP should lead to a set of initial plans and specifications that support the accurate estimation of project costs. The project schedule should include an estimate of the length of time required to undertake anticipated contracting and procurement methods and to perform both the remaining engineering design and the Construction/Procurement phases. A preliminary maintenance schedule and an estimate of annual labor hours and costs should be prepared for the planned system in revenue service. A conceptual definition and an estimate of start-up costs should be included with the initial cost estimate. This estimate should include integrated pre-operation testing, pre-revenue and start-up costs, as well as the assessment of materials, equipment, and spare parts required. A summary of the typical initial outputs for each subsystem includes:

- Function
- Capacity
- Configuration
- System integration and interfaces
- Materials/equipment
- Capital cost
- O&M requirements and general procedures
- O&M labor requirements
- O&M cost
- Schedule requirements
- Expansion capabilities
- Flexibility for future changes
- Impact on reliability, availability, and safety
- Preliminary plans and specifications
- Sources of supply and market competitiveness
- Supporting documentation – general provisions, standards, etc.

The following section addresses many of the design criteria development issues for typical fixed guideway subsystems.

- *Vehicles* – The number of vehicles required is based upon vehicle capacity, patronage projections, schedule, and service standards. Vehicle performance requirements should be evaluated to assure that planned service schedules can be met. Relevant vehicle subsystems should be defined and evaluated in terms of vehicle reliability, maintainability, and performance. The selected vehicle wherever possible should be similar to and compatible with the Project Sponsor's existing rolling stock fleet to minimize training, O&M, and purchasing complications.

- *Traction power* – Prepare preliminary design of the power system that locates all major subsystems such as substations and power sectionalization. Define and evaluate substation size, spacing, equipment, and safety and security requirements considering:
  - Planned service levels
  - Alternate voltage levels
  - Power delivery options
  - Back-up systems
  - Power control
  - Necessary redundancy
  - Vertical and horizontal alignment compatibility with revenue vehicles and maintenance equipment/vehicles

  Determine the line voltage equipment type and sizes, traction and ancillary power usage split, and power delivery system. Evaluate alternative emergency power supply requirements and examine local power utilities back-up requirements, procedures, and problems. This should include investigating power sources, peak requirements, rate structure, and reliability analysis. Determine those system units that can be prepackaged in accordance with local union agreements and, where applicable, recommend pre-purchase options.

- *Ancillary power* (electrical distribution for support facilities) – Determine voltage, type of equipment, power source, equipment size, and emergency backup requirements for the ancillary power system, along with appropriate room sizes that are required for the equipment.

Safety Considerations in the Design of Grade Crossings

Although the Manual on Uniform Traffic Control Devices (MUTCD) can provide guidance. The unique properties of grade crossings between highways and rail transit (LRT, some Commuter Rail, etc.) require their own standards and guidelines for the design, installation, and operation of traffic control devices separate from those for grade crossings between highways and freight railroads. It is critical for the public agency with jurisdictional authority and the transit operator to coordinate their efforts in the installation of these devices.

- *Train control* – Study alternate systems of vehicle or train control including wayside signals, cab signaling systems, central control, and train supervision with consideration of the initial and life cycle costs and the long-term probabilities of state-of-the-art modifications and their effect on the planned operation of the transit system. Evaluate potential use of Communication Based Train Control (CBTC) or Positive Train Control (PTC) as well as any impacts of the Rail Safety Improvement Act of 2008 [Ref. 4-2] for the particular transit system application. Study the compatibility of various manufacturers' equipment in the same control system to evaluate advantages or disadvantages and costs. Identify the number and location of interlockings required and the location and size of major equipment rooms or bungalows. Identify those systems that can be pre-packaged in accordance with local labor agreements. Where applicable, consider interoperability with tenant and/or outside host railroads.

- *Traffic signal system interface* – LRT, commuter rail, and BRT systems often operate with at-grade crossings of streets and highways. Project Sponsors should work with local traffic management agencies to obtain their approval to integrate the transit project with the roadway traffic signal system. Project Sponsors should coordinate with project stakeholders to conduct on-site crossing or intersection diagnostic evaluations to better understand current traffic operations and proposed changes. For maximum throughput, priority for transit vehicles should be a common goal; maximizing safety and reducing wear and tear on vehicles and the guideway are also benefits. The "priority" to transit vehicles typically involves the shortening of the (rubber-tired) traffic signal cycle to allow transit to pass through the crossing or intersection while allowing any current signal phases the minimum time to complete, as is needed to allow pedestrians to reach a safe zone. With certain exceptions, full "Pre-emption" is typically reserved for emergency vehicles.

Communications – Study, evaluate, and select appropriate systems for:

- Telephone service
- Data transmission
- Public address systems
- Passenger information displays
- Variable message signage

  - Security, including cameras (CCTV), intrusion detection and access control systems, barriers, emergency telephones, and other physical security equipment
  - Fire detection
  - Mobile radios
  - Cable systems
  - Fare collection

  Applicable systems should be compatible with the requirements of existing police and fire communications systems. Further, consideration should be given to customer needs relative to cell phone and personal data/computer connectivity and use in tunnels, etc.

- *Ventilation* – Determine types of ventilation needed for indoor facilities, including consideration of appropriate modes of response to emergencies, such as smoke, fire, and weapons of mass destruction (WMDs), including chemical, biological, and nuclear. Ventilation types may include:
  - Natural air system
  - Under-platform exhaust system
  - Mechanical ventilation, both normal and emergency
  - Air cooling system (if provided) for stations and/or offices

For additional information on these topics, see the following references:

  - ☞ *The Subway Environmental Simulation and Environment Design Handbook* [Ref. 4-3] provides detailed guidance on the topic of subway ventilation.
  - ☞ Making Transportation Tunnels Safe and Secure [Ref. 4-4]
  - ☞ *Guidelines for Managing Suspected Chemical and Biological Agent Incidents in Rail Tunnel Systems* [Ref. 2-55] includes ventilation recommendations.

- *Fare collection* – Study and evaluate alternative systems of fare collection and revenue control based on any existing Project Sponsor fare system structure, local and regional fare policies and system integration, fare evasion projections, capital and operating costs, and in consideration of system expansion.

- *Trackwork* – Develop preliminary horizontal and vertical centerline alignments. Determine the trackbed requirements to adhere to noise level standards and operational criteria developed under the system definition task. Select rail section and gauge. Prepare preliminary trackwork plans and profiles, special trackwork, typical sections, details and specifications for the entire fixed guideway system, including yards and maintenance facilities.

- *Drainage* – Prepare a layout of all drainage required for roadbed, track structures, yard and shop, stations, parking lots, downstream improvements, detention, ancillary rooms sumps and discharge points. Determine the need for permits and approvals, including authorization to discharge wastewater. Also, identify the need for specialized equipment, such as oil separators.

- *Safety, Fire Protection, and Security* – In addition to the FTA-mandated, Safety and Security Management Plan (SSMP), the Project Sponsor should develop a project-wide safety and security design criteria plan or manual that is consistent with all applicable local and state codes and transit industry standards. Local and state approvals for proposed systems should be obtained, where necessary. The plan, which should be included in all bid documents so contractors are aware of the safety and security requirements for their work and their specific worksites, should include the following systems:
    - Site-specific safety and security requirements for each project phase
    - Fire detection and protection system
    - Fire management and control plan

  As the project develops, professional staff or consultants should work with the design team to develop the emergency plans that will be required during revenue service, including:
    - Passenger emergency right-of-way egress plan
    - Station evacuation plan
    - Train evacuation plan (mandated for FRA-covered projects)

  ☞ The National Fire Protection Association [Ref. 4-1] establishes minimum fire protection requirements for fixed guideway transit subsystems. Local jurisdictions should be consulted on code adoption.

  Section 0 addresses system safety and security requirements and approaches that will result in design criteria for systems and equipment.

- *Work equipment* – Develop a work equipment requirement list and acquisition schedule. These should include all specialized maintenance of way and systems maintenance equipment such as tampers, speed swings, ballast regulators, tie inserters, work trains, rail grinders, test equipment, etc., and all major shop and field service equipment and field service vehicles. They should also include safety equipment, radios, and vehicles for security and operating personnel.

4.4.1.7 *Computer-Assisted Design and Drafting*

CADD software packages can be extremely helpful in developing drawings and design specifications. CADD and companion software permits planning, cost estimation, cost allocation, and maintenance planning. A CADD system maintains a database of standard elements that can be easily incorporated into a design. Summary and detailed lists of equipment and material quantities can be rapidly produced for alternative design combinations. CADD is also a useful tool for ensuring compatible design interfaces.

The Project Sponsor should establish CADD standards for the project, which would define software requirements, software compatibilities, file naming conventions and standards for levels or layers, line types, weights, colors, pen tables, borders, plot setup files and directory organization. The CADD standards should require that, except for schematics, all CADD drawings be drawn accurately and all plan views should be in the project coordinate system. Different design discipline personnel should be able to reference each other's drawings into their own to check for conflicts and incompatibilities.

Safety – Hazard Management Programs

Accident risk is a major concern for the transit industry. Safety incidents are estimated to exact costs in the billions each year, saying nothing about lives lost or bodies maimed. System Safety Program Plans and proactive hazard management programs have been shown to cut safety risks and costs. Nevertheless, agencies sometimes contend that safety recommendations often may not be very sensitive to costs, which can produce disagreements between design/construction and safety staff. Effective partnerships are needed to resolve these divergent perspectives and resolve disputes. Some agencies have persuaded local authorities to institute photo enforcement programs at rail transit grade crossings and reduced accidents significantly.

CADD standards may require surveyors to provide 3D CADD versions of base mapping of existing planimetrics and topometrics as well as a digital terrain model (DTM) of the existing conditions in the area in which construction is to occur. Civil designers may then create 3D CADD models of proposed grading and drainage work in order to display accurate representations of civil work on grading plans and cross sections and to determine earthwork quantities for estimates.

4.4.2 Applicable Codes and Standards

To guide the design process, the Project Sponsor or its consultant must compile a list of all applicable Federal, state, and local codes and standards for the project. One such Federal requirement is ADA compliance, discussed in Chapter 3. The Safety and Security topic in Chapter 2 describes FTA's requirement for developing an SSMP for each project. While SSMPs are required in conjunction with obtaining new Full Funding Grant Agreements (FFGAs), many of the principles can be applied to all capital projects. Circular 5800.1 defines the applicable projects for which SSMPs are required (recipients with major capital projects, as defined in 49 CFR 633.5)

SSMP requirements, as indicated in Section 2.2.11 are quite specific for each phase of a project and are given detailed reviews by FTA (usually relying on its PMOC). Oversight of an SSMP includes a review of the SSMP and related plans, policies, and procedures that the SSMP refers to or incorporates. The PMOC may also conduct SSMP adherence reviews, which include on-site inspections and interviews with the Project Sponsor, or consultant personnel the PMOC has indicated in advance were selected due to their roles in the project. Circular 5800.1 [Ref. 2-49] provides specific guidance on the requirements of the SSMP's development and organization.

The SSMP should be developed very early in the project process and provided as part of the contract procurement documents to ensure sufficient implementation. Consistent with other project plans the SSMP must clearly identify the roles and responsibilities of the project staff, contractors, and stakeholders responsible for managing safety and security. Circular 5800.1 [Ref. 2-49] provides specific guidance on the requirements of the SSMP's development and organization. The SSMP includes the following 11 sections:

1. Management Commitment and Philosophy
2. Integration of Safety and Security into Project Development Process
3. Assignment of Safety and Security Responsibilities
4. Safety and Security Analysis
5. Development of Safety and Security Design Criteria
6. Process for Ensuring Qualified Operation and Maintenance Personnel
7. Safety and Security Verification Process
8. Construction Safety and Security
9. Requirements for 49 CFR Part 659, State Safety Oversight
10. FRA Coordination
11. DHS Coordination

The SSMP is to be submitted to the FTA for review and approval at each project phase. The circular's Appendix A (SSMP Checklist) provides a checklist of requirements at each phase of a project. Project Sponsors should review it carefully.

In addition to the PMP and the SSMP, activities and documents that should have been undertaken or created during PD include, but are not limited to:

- *Safety and Security Certification Plan (SSCP)* – normally created prior to and updated during Engineering.
- *Certifiable Items List (CIL)* – grows as the project moves through phases.
- *Safety and Security requirements* – setting forth responsibilities for safety/security, including possibly, PHAs, TVAs, site safety/security responsibilities, operating and maintenance procedures, training plans, System Integration Test Plan (STIP), and similar areas for which the Project Sponsor intends to hold the GEC responsible.
- *Preliminary Hazard Analysis (PHA)* – typically created prior to and updated Engineering Phase. Includes analysis conducted for project specific hazards that need to be addressed through design and procedures.
- *Operational Hazard Analysis (OHA)* – normally created prior to testing and updated through pre-revenue operations. Includes analysis of unmitigated PHA hazards, and additional hazards identified after construction is complete.
- *Threat and Vulnerability Assessment (TVA)* – typically created prior to and updated during Engineering Phase. Includes security related assessments for project specific threats and vulnerabilities that includes counter measures. The TVA may include Sensitive Security Information that adhere to 49 CFR 1520.

- *Existing safety and security design criteria or specifications* – particularly for large projects with multiple contractors, the Project Sponsor should develop safety and security design manuals and contractor/construction safety and security plans to distribute with bid documents.
- *Applicable codes, standards, and regulations*
- *Safety and security design reviews and approvals*

During each project phase, it is expected by FTA that the steps outlined above will have been updated and that additional safety and security elements have been put in place. Project managers will be expected to have undertaken or updated:

- *PMP, SSMP, SSCP, and Certifiable Items List (CIL)* – The CIL by this phase should include subsystems.
- *PHA* – The initial analysis should have been completed, updated, and reviewed by executive management.
- *TVA* – The initial assessment should have been completed, updated, and reviewed by executive management.
- *Safety and Security Design criteria (or manual).*
- *Review of safety and security performance requirements* – For large projects, the review should have resulted in development of a contractor and/or a construction safety and security manual.
- *Safety and security design reviews and approvals*.

Incorporating Safety into Design – Four Quadrant Gates

When several commuter rail systems undertook rehabilitation or new lines, they included the evaluation of four-quadrant gated crossings. The four-quadrant gate system demonstrated that new technology combined with traditional grade crossing applications and enhanced feature elements are effective and reliable to control motorist movement at an activated highway-rail intersection. Other viable alternatives, such as roadway medians, pedestrian gates, and rail transit specific signage should be considered during the initial Engineering phase of the project.

At the completion of the Engineering Phase, the steps up to this point should include updating or adding to:

- PMP, SSMP, SSCP, and CIL
- PHA and Hazard Analysis Reports (HARs) for civil and system elements
- Safety and security technical specifications, completed and approved, and conformance verification checklists developed
- Preliminary test plan requirements
- Project emergency procedures
- Safety and security design reviews and approvals

Additional safety and security requirements for later project phases are described in Chapter 5 and Chapter 6.

4.4.3 Honoring Mitigation Commitments made during the NEPA Process

NEPA requires Federal Agencies to perform environmental analyses to determine the environmental consequences of their proposed actions. Mitigation and monitoring are important tools agencies use to avoid, minimize, or compensate for potential adverse environmental impacts associated with their actions. When Federal Agencies conduct Environmental Assessments (EA) and Environmental Impact Statements (EIS) in accordance with NEPA, they often commit to mitigating the environmental impacts of a proposed action [Ref. 4-6].

When Project Sponsors base their environmental analysis on a commitment to mitigate the environmental impacts of a proposed action, they should embody the commitments in the decisions documents (i.e., FONSI) for EAs, Record of Decisions (ROD) for EISs), adhere to those commitments, monitor how they are implemented, and monitor the effectiveness of the mitigation.

Specifically, Project Sponsors should:

- Commit to mitigation in decision documents when they have based environmental analysis upon such mitigation (by including appropriate conditions on grants, permits, or other agency approvals, and making funding or approvals for implementing the proposed action contingent on implementation of the mitigation commitments).
- Monitor the implementation and effectiveness of mitigation commitments;
- Make information on mitigation monitoring available to the public, preferably through agency websites.
- Remedy ineffective mitigation when Federal action is not yet complete. [Ref. 4-6]

Project Sponsors should develop internal processes for post-decision monitoring to ensure the implementation and effectiveness of the mitigation. The CEQ encourages the use of adaptive management as part of a proposed action. Adaptive management, when included in the NEPA analysis, allows for the Project Sponsors and Federal Agencies to take alternate mitigation actions if mitigation commitments originally made in the NEPA and decision documents fail to achieve projected environmental outcomes [4-6].

The Project Sponsor must assure that the mitigation measures for which commitments were made in the NEPA process are reflected in the design criteria going forward and the Engineering drawings and specifications.

4.5 Real Estate Acquisition

Real property to be used in a Federally-assisted transit project must be acquired and its occupants relocated in compliance with 49 CFR 24 [Ref. 4-5], the regulations that implement the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 as Amended (Uniform Act) [Ref. 4-7]. Compliance with FTA’s Circular 5010.1D is also required, specifically Chapter I, Section 5. DEFINITIONS and Chapter IV, Section 2. REAL PROPERTY are applicable. A project’s acquisition and displacement activity must also comply with individual state statutory and judicial case law that may be applicable.

The Project Sponsor has pre-award authority to acquire property after the issuance of the environmental document, i.e., ROD, FONSI, or CE, but Federal participation is not assured until there is a grant authorizing acquisition activities. Because the acquisition of property can prejudice the alternatives selection process, generally only certain ROW corridors and associated property can be acquired prior to issuance of the project's environmental document. There is latitude to address corridor preservation, hardship and protective purchase parcels early in the process. Any use of these exceptions must be coordinated with FTA and must meet specific criteria.

☞ FTA guidance for real estate is available on the FTA website under New Starts/Small Starts – Real Estate [Ref. 4-8]

4.5.1 Early Real Estate/Right-of-Way (ROW) Activities

Real estate involvement should begin as early as the PD Phase, and will necessarily be integrated into the NEPA environmental impact documentation process. The environmental process is required to analyze socio-economic impacts that may be caused by a project and any alternatives under consideration. A real estate and/or relocation assistance expert can provide helpful input to the analysis and reporting of such impacts.

☞ Frequently Asked Questions regarding changes to relocation benefits and eligibility under MAP-21 are available at the FTA website. [Ref. 4-9]

A real estate acquisition and management program should begin in earnest during Engineering or earlier, as indicated previously. A Real Estate Acquisition and Management Plan (RAMP) is required as an integral product of the PMP. Qualified real estate/ROW professionals should provide input into the decision-making process regarding potential alignments and property damage mitigations, which often saves money and time as the project progresses. Input is primarily through studies regarding acquisition and relocation impacts, costs, and time constraints for different options.

A Project Sponsor's real estate staff or real estate consultant must have an understanding of:

- Legal requirements
- Acquisition and relocation requirements
- How to estimate time and cost to assure no delays and cost overrun

An outline of the required content of the RAMP is contained in Appendix B of FTA Circular 5010. The RAMP content should follow those items outlined by FTA (in the circular's Appendix B), including the following general topical areas:

- *Introduction/Scope* – Description of the real estate to be acquired, displacements of families and businesses and the process to implement
- *Organizational Structure* – Real estate staffing by employees/contractors and delineation of responsibilities
- *Acquisition Schedule* – Addresses due dates for ROW clearance and certification of availability for construction
- *Real Estate Cost Estimate* – Includes land, improvements, damages, condemnation and settlement overages, relocation assistance and overhead/administrative costs
- *Acquisition Process* – ROW plans, titles, valuation, offers of just compensation, closings/escrows, condemnation and settlements
- *Relocation Process* – Administer residential and business relocation benefits and services, and handle appeals as needed on the project
- *Other Components* – Involve document control, property management and excess property inventory and utilization plan

The Project Sponsor may in conjunction with or in addition to the development of the RAMP also develop the following in its real estate program, as applicable:

- *Identification/Certification of Real Estate Required* – ROW (permanent/ temporary), easements (permanent/temporary), and lesser interests (permanent/temporary).
- *Appraisal* – The development of an appraisal scope of work (SOW) required by URA implementing regulations. See also, Appendix – of FTA Circular 5010 for additional information on the detailed requirements for the appraisal SOW.
- *Acquisition* – Title commitments, negotiators, closing agents/attorneys, eminent domain attorneys for potential condemnation, and others.
- *Property Management*– Interim use/maintenance prior to project construction and management of excess property prior to disposal.
- *Relocation Planning* – Early conceptual studies to be followed with advance planning adequate to effectively relocate occupants and personal property from the property needed for the project in accordance with governing regulations.
- *Demolition* – Procurement and administration of demolition contracts and use or sale of improvements and salvable materials. Safety and security concerns should also be addressed in this plan.
- *Real Property Inventory* – Property believed to be in excess shall be inventoried for later joint development ventures, disposal, and other potential uses. Security-related issues surrounding the maintenance of empty structures should be considered when determining policies for property that will remain vacant for any lengthy periods. If such properties become associated with criminal events or become community eyesores, the community will see the project or the Project Sponsor as bearing responsibility for activities on and around the property.
- *Schedule and Funding* – Schedule of all real estate and real estate-related activities to meet requirements for project cost estimating and budget development, project real estate program scheduling and its correlation to and with

the project's Integrated Master Project Schedule (IMPS), program administration and accounting.

- *Transit Joint Development* – While not necessarily developed by the real estate organization, this planning documentation should provide an assessment of opportunities in conjunction with local land use plans and innovative financing techniques that may influence the real estate program.

4.5.2 Real Estate Acquisition-Implementation Phase

The RAMP initially established in PD must be refined to reflect plans and specifications as Engineering proceeds. Where realignment or changes in plans that affect real estate have occurred, the acquisition plan's cost, scope, and schedule must be updated.

All real estate necessary for construction work must be acquired in accordance with the construction schedule. This means prior to the award of a contract and, preferably, before advertisement for bid, except under some alternative delivery methods where the schedule for delivery of ROW is set in the agreement. This is because uncertainty regarding the availability of the needed ROW affects contractors' bids. If the ROW is not available at the start of construction, contractors may have to "work around" unacquired parcels in order to maintain the project schedule, creating the potential for contractor claims.

Since many transit projects involve real estate acquisition, it is essential that each have a comprehensive real estate program. This is particularly so for Federally assisted construction projects subject to the legal requirements of the Uniform Act and state law. In addition, environmental laws at the Federal and state levels increase the liability connected to real estate acquisition. Issues related to alignment and real estate acquisition have had major impacts on transit project capital costs.

Real estate issues must be closely coordinated among the project planners, programmers, designers, engineers, environmental, safety and security specialists, construction managers, and the project's real estate organization. This coordination should assist each team element in understanding the functions and needs of the other team

Public Outreach Program Related to ROW Acquisition

Light Rail and Commuter Rail Transit projects generally cross-political jurisdictions and involve the participation of a number of local, state, and Federal agencies, public and private institutions, businesses, and the general public. Rights-of-way for the proposed project are rarely acquired without extensive effort and often those whose property is taken or impacted do not understand the process and are not satisfied with the results, even if they support the project. Public outreach programs which include a focus on property acquisition can be used to facilitate the process by working with the community at large and individual property owners (and tenants) to help them understand the process and help the agency staff understand and respond to constituent concerns. Public outreach may also help reduce the length of time required to acquire property through improved understanding and communications.

members so that the development of a real estate program schedule reflects the time required for acquisition (including relocation of existing occupants) and demolition of properties. Delays may also occur as the result of the need to utilize the power of eminent domain to acquire needed property by condemnation. This judicial process can be unpredictable in terms of the timing in obtaining the physical possession of the property needed for the project's construction.

This real estate schedule must be incorporated with all other functional schedules to form the Integrated Master Project Schedule (IMPS) baseline and be flexible enough to meet program modifications. For example, partial acquisitions can neither be defined nor acquired without an advanced level of design completion. Therefore, when project design is not delivered on schedule, it has a domino effect on the entire project schedule. Moreover, a design change – even one that reduces an acquisition area – will require the real estate group to re-initiate the valuation (and possibly negotiations) for that parcel. Any such reworking of real estate parcels after the acquisition process has started, adds cost, can adversely affect schedule and cause distrust with project stakeholders and affected property owners.

The Project Sponsor's Project Management Plan (PMP) should clearly identify the responsibilities for real estate acquisition, locations, availability, restrictions, residual prerogatives of former owners, and any special covenants or construction precautions that must be observed. Real estate program documentation and individual construction contracts must specify, in detail, the restrictions and provisions for the construction policies and methods on public and private lands. This is particularly important if there are requirements to retain certain landscaped finishes and special requirements for drainage and land restoration at the conclusion of the project.

4.5.3 Relocation Process Considerations

The law requires that residential occupants displaced by the project be offered a comparable dwelling that is decent, safe, and sanitary, and made affordable through supplemental payments. Thus, a failure to conduct timely interviews to understand individual comparability, affordability, and "decent, safe, and sanitary" needs could unexpectedly affect the project schedule.

Similarly, business, farm, or non-profit organization occupants must be interviewed and afforded assistance in relocating to a new site. Some business type displacees may require an extensive period to time to relocate an existing complex or large operation that could require many months to accomplish before clearing the project for construction. If such business moves are not appropriately facilitated, the project could be delayed and/or the business may be adversely impacted with resultant economic impact to the immediate area.

4.5.4 Contaminated Property (including Brownfields)

A determination must be made whether a property to be acquired contains hazardous materials. The Project Sponsor must also assess the impact on the property value and determine the measures necessary to protect the public during remediation and construction.

If a project involves contaminated property (including “brownfields”), appropriate due diligence regarding contamination is conducted as a part of the NEPA process and discussed in the NEPA document before selection of a contaminated property in a capital project. Appraisals should consider the effect, if any, contamination has on the market value of the property being valued. The terms *contamination* and *hazardous material* should be interpreted broadly to include all contaminants that can affect property value and which are subject to environmental controls.

If it is necessary to purchase a contaminated property, the Project Sponsor must also assess the impact on the property value and determine the measures necessary to protect the public during remediation and construction. If property contamination is found within the project limits and is impossible to avoid, then it is desirable to:

- Mitigate the contamination to an acceptable standard for the most reasonable cost
- Hold property owners responsible for the cost of remediation of the contamination
- Maintain the project schedule, if possible, while undertaking the necessary remediation

4.6 Negotiation of Third-Party Agreements

All project activities requiring interagency agreements and approvals must be identified and scheduled in project development or at the latest early in Engineering and executed before FFGA or SSGA. These should include, but not be limited to:

- Utility relocations and/or new utility service agreements (see Appendix F – Utility Relocation Agreements)
- Encroachment on other public transportation ROWs
- Permits and/or waivers

It is normally necessary to relocate or rearrange existing facilities prior to the construction of a major transit project under traditional delivery methods. This includes franchise utilities (power, telephone, cable, gas, steam, etc.), public facilities (highways, streets, sewer, water, drainage, fire services, traffic control, etc.), and railroads. Other than environmental permits, D/B and similar delivery approaches often transfer the responsibility for some or all of utility relocations and construction permits to the private party.

Master agreements should be developed and negotiations completed with utilities and with public and private agencies during project development or at the latest in early stages of Engineering before SSGA and/or FFGA. The agreements should ensure that the project will not be delayed either as design progresses or during construction and should provide for the following:

- Scope of work and obligations/rights of both parties
- Responsibility for design
- Acceptance of improvements criteria (short of agreeing on "betterments")
- Responsibility for construction and relocation/rearrangements
- Responsibility for inspection
- Responsibility for safety and security of the site(s)
- Procedures for billing and payments
- Disputes resolution procedures
- Preparation and terms of detailed agreements
- Salvage materials/credits
- Responsibility for the acquisition of substitute easements
- Substitutions and betterments
- Conflict resolution procedures
- Improvement and replacement standards
- Parameters for scheduling work

The need for interagency agreements and approvals should be continually monitored throughout Engineering in preparation for commencement of construction. The master utility agreements initially negotiated during project development or early Engineering should be refined into detailed agreements as the design progresses for each contract/section and should indicate provisions for the following:

- Detailed design for specific relocation/rearrangement, and/or new services
- Schedule
- Cost, salvage, and betterment
- Conditions of performance
- Responsibility for safety and security of the site(s)
- Payment for services
- Work orders (direction to proceed)
- Criteria and process for acceptance of work

4.6.1 Governmental Jurisdictions

Transit projects involve interaction with government agencies as funding partners, regulators, or representatives of the communities in which the project will operate. The role of each agency must be negotiated after an early examination of its requirements without jeopardizing the project's public support or schedule. In many cases, there is no direct link between an agency's needs and its requirement to provide the funding to support the transit project.

4.6.2 Utilities

Utilities can have both a direct and indirect impact on a project. Direct impacts occur when a utility connection is required for the project itself, such as electricity, water, and telephone. Utilities are involved indirectly when their infrastructure must be relocated to make way for the project. The Project Sponsor is required to determine who is responsible for acquiring easements for relocating utilities and assuring that all permits, etc. are obtained.

Internal FTA White Paper: Utility Agreements

Transit projects frequently require the relocation of utilities, defined in 23 CFR, Part 645, Subpart B, Section 645.207 as a "privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing various resources." A "utility agreement" is a legally binding document between a utility company and a transit agency that defines the scope of a relocation, including reimbursement, liability, right of entry, insurance, and schedule to complete the work. Such an agreement is essential to properly identify the parties involved and to ensure that all parties have a complete understanding of the scope, schedule, and reimbursement issues relating to the relocation. Utility agreements have long been the means by which a Project Sponsor arranges for a utility to relocate its facilities from within the footprint of a proposed project. See Appendix C for the complete Working Paper.

In some cases, lateral or longitudinal utility corridors created by the project can accommodate more efficiently the relocation of several utility facilities by bundling or co-location. If this design feature is used, then any additional real estate interest needed must be incorporated into the ROW design for the project so it can be acquired with other property parcels of real estate.

4.6.3 Railroad and Other Transportation Entities

Railroads and other transportation entities (including the FAA and state and municipal transportation agencies) may control property that a Project Sponsor needs to acquire or to access (either temporarily or permanently) to construct or operate a transit project. The Project Sponsor must begin negotiation early in the project's development process to assure successful resolution of any conflicts. It is important that early on, an "understandings paper" or some kind of outline of an agreement be created to set the basis for the project. This may include an operating plan, frequency of service, improvements to be constructed, who will pay, who will construct, and what is the permit/approval process. If these terms can be worked out in advance with a reasonable and narrow "order of magnitude" final costs forecast, PD can continue with an understanding of the basis of an affordable and high probability agreement. Projects that come under the jurisdiction of the Federal Railroad Administration (FRA) and Federal Aviation Administration (FAA) require a number of documents that are not mandated by FTA. Sponsors whose projects require FRA or FAA coordination should meet with their FRA and/or FAA regional personnel to determine their responsibilities in this area. Whether or not a railroad corridor is subject to Surface Transportation Board (STB) regulation will determine the approach taken relative to consideration of possible acquisition scenarios.

Often, an existing railroad corridor right-of-way (ROW) may be a viable alternative for development of a transit project. This option can be available in various configurations as follows:

a. An abandoned unused corridor not subject to STB regulation
b. An unused corridor that has not been abandoned and thus is still subject to STB regulation, but possibly may be approached based on pursuing an "involuntary abandonment".
c. An operating corridor where sufficient ROW is available for transit to co-exist with freight or other passenger operations, without sharing tracks
d. Same as c., except freight and other facilities must be relocated or adjusted to accommodate transit and/or transit may have to acquire additional ROW
e. Same as c., except there is not sufficient ROW available for transit to have exclusive track facilities and therefore must share track with freight or other operations. This may involve potential "cost to cure" adjustments in existing facilities for the various operations to co-exist. Most adjustments required to accommodate transit would be an eligible project expense, so long as they were reasonable and necessary.

There may be additional scenarios that occur, but these are most typical. Items b. through e. would typically be subject to STB regulation. Where this is the case, generally a state or local agency cannot use its power of eminent domain to condemn the property owned by the railroad if an agreement could not be reached, because of the STB's authority or control.

Section 20016 of MAP-21 amended Federal transit law by adding a new provision at 49 U.S.C. § 5323(q) that allows the Federal Transit Administration (FTA), under certain conditions, to assist in the acquisition of right-of-way (ROW) before the completion of the environmental review process under the National Environmental Policy Act (NEPA) for any transit project that eventually will use that ROW. The new provision, effective on October 1, 2012, states:

> *(q) CORRIDOR PRESERVATION.—*
> *(1) IN GENERAL.—The Secretary may assist a recipient in acquiring right-of-way before the completion of the environmental reviews for any project that may use the right-of-way if the acquisition is otherwise permitted under Federal law. The*

> *Secretary may establish restrictions on such an acquisition as the Secretary determines to be necessary and appropriate.*
> *(2) ENVIRONMENTAL REVIEWS.—Right-of-way acquired under this subsection may not be developed in anticipation of the project until all required environmental reviews for the project have been completed.*

Prior to October 1, 2012, FTA only allowed corridor preservation of pre-existing railroad ROW for a future transit project prior to completion of the environmental review process for that project, pursuant to the former 49 U.S.C. § 5324(c). Section 20016 of MAP-21 created a substantially similar provision in 49 U.S.C. § 5323(q), but removed the word "railroad."

MAP-21 did not, however, change the prohibition on the acquisition of real property that is not "right-of-way" prior to the completion of the environmental review process for the transit project unless conditions for certain exceptions (hardship and protective acquisitions) are met. See 23 CFR § 771.113(a). This guidance is intended to address the conditions for corridor preservation under 49 U.S.C. § 5323(q), including FTA's definition of ROW for that purpose. This guidance also provides information on FTA's expectations and requirements for acquisition of ROW prior to completion of the NEPA environmental review process for the project that will occupy the ROW. This guidance does not address the long-standing use of hardship or protective acquisitions, which are described in FTA's NEPA regulation at 23 CFR § 771.118(d)(3). FTA has issued Final Guidance on the Application of 49 U.S.C. § 5324(c) to ROW Acquisition [Ref. 4-10] and § 5323(q) to Corridor Preservation for a Transit Project. This policy is available on the FTA website.

Nonbinding mediation is now available in accordance with Section 401 of Title IV of the 'Passenger Rail Investment and Improvement Act of 2008. This Section requires Commuter Rail Mediation to be made available by the STB. This alternate dispute resolution initiative may enhance the importance for transit Project Sponsors to produce objective and well-documented proposals to utilize a railroad ROW. Relevant and well-scoped valuation/appraisal reports pertaining to the railroad property needed should also facilitate reasonable agreements with railroad corridor owners.

If there is consideration of the use of an existing railroad ROW corridor, the transit agency must be informed of all possible options and/or approaches to the acquisition of a railroad property interest. Taking the following steps can help to ensure successful conduct of the acquisition plan:

- Retain an expert in STB regulation of the specific railroad interest under consideration for acquisition to outline and report the possible alternatives, responsibilities, and potential options to consider under the existing circumstances.
- Compile all available data relative to the specific status of the corridor. The recommended specialty report should also include the compilation <u>of all relevant data</u> regarding the current existing use or non-use of the subject railroad ROW corridor, including, but not limited to:

- Shippers served
- Train traffic and size and the number of trains per day or week, based on averages for the last year and for five years.
- Date of the most recent trip
- Tonnage shipped for the last year and for 5 years
- Existing rail improvements and condition thereof
- Overall freight capacity of the corridor and any potential diversion or delays caused by the introduction of transit.
- Possible adjustments in existing railroad facilities to accommodate transit
- Other relevant data related to the line's operation.

- Based on the above analysis, an approach for utilization of the existing railroad ROW corridor should be formulated.
- This analysis should be undertaken in coordination with the owner of the corridor
- This approach must be incorporated into a real estate appraisal scope of work (required by 49 CFR Part 24, Subpart B) along with other valuation requirements specified in the Uniform Standards of Professional Appraisal Practice (USPAP) and the Federal URA appraisal standards. The data and conclusions of this specialty report will be utilized by the real estate appraiser to analyze the highest and best use of the corridor, which is a necessary premise in the valuation assignment.
- This will result in the transit agency being fully informed as to the:
  - STB control considerations
  - Existing and highest and best use of the existing corridor
  - Estimate of the value of the property as a transportation corridor for transit
  - Estimate of the cost of any modifications to the existing corridor necessary to accommodate the transit facilities

4.6.4 Environmental Compliance

Project Sponsor interactions with all affected environmental oversight agencies and organizations should be directed at establishing relationships that will support the negotiation of detailed agreements and permit the project to advance while complying with the need to mitigate all project related negative impacts. These relationships should begin during PD with execution of the NEPA process requirements and evolve into formal agreements during Engineering before FFGA or SSGA The agreements should define Project Sponsor and agency responsibilities, authorities, and processes during the Construction/Procurement and Revenue Service phases. The development of a matrix identifying the necessary agreements and/or permits needed should be initially prepared during the NEPA process to track these vital project impacting items, and subsequently updated and (as necessary) expanded during Engineering. Likewise, the key agreements and/or permits should be integrated with other activities and presented within the project's Integrated Master Project Schedule (IMPS). See Section 2.2.7 for additional guidance.

4.6.5 Joint Development

Joint development in conjunction with a transit project can be a complex public-private partnership that requires lengthy periods of planning and negotiation to reach agreement. The actual Joint Development agreement should specify the relative and explicit responsibilities between the parties. To obtain maximum value from joint development approaches, early involvement of the private partner is recommended so that the synergies can be explored and synchronized. If this process is not engaged early, the project could impeded by decisions that may minimize, if not all together eliminate, the opportunities for joint development. See Section 2.2.10 for additional guidance.

4.7 Completion of Engineering

4.7.1 Design Coordination

As the design progresses from the initial phases of engineering, coordination of the following is required:

- The objectives of the project as defined during the PD Phase
- The design and operations criteria established during PD
- Regulatory bodies and governments with jurisdiction
- All of the project stakeholders, both external agencies and the Project Sponsor staff, representing:
    - Operations
    - Maintenance
    - Planning
    - Engineering
    - Architecture
    - Safety
    - Security
    - ADA compliance
    - Procurement contracting
    - Real estate
    - Public Involvement
    - Scheduling
    - Estimating
    - NEPA Process
    - Other functions, as appropriate

Coordination is generally less formal at the beginning of the design process and more formal as the design is refined and requirements are better defined. In addition to the involvement of external stakeholders, the public involvement program should inform and receive input from potential system users and the public at large.

Starting with the baseline established during PD, the description of the project will evolve as Engineering design progresses, culminating in the construction procurement documents. The Project Sponsor must establish a configuration management process to document the process and the justification of changes proposed and approved to the

Baseline Project Definition, with transparency in the analyses of the effects of every change on the project's budget and IMPS. The process must document the approvals by appropriate and fully authorized representatives of the Project Sponsor's staff and, where warranted by the requirements of the PMP, provide a full record of the decision-making by the Project Sponsor's senior executive management and governing body. See Section 3.5.4 for additional guidance on principles for controlling project configuration and changes, Section 3.5.5 and Appendix E for proactively identifying and resolving risk, and Section 5.2.8 on configuration management during construction.

4.7.2 System Integration

The purpose of the system integration function is to ensure compatibility among the various elements of the project and between the project and the existing transit system, if applicable. For fixed guideway transit projects, the systems to be integrated may include the guideway (structures, track, roadway), traction power (substations), power distribution (catenary, third rail), control (central control, signals, train control), communications (operator, public, emergency response), vehicles, existing security systems (e.g., surveillance systems, emergency telephones, public address systems, access control systems), ventilation, yards and shops, and O&M rules, procedures, and training.

As Engineering develops, the system integration function should consist of interdisciplinary reviews by management and staff following these steps:

- Assure that the documents fulfill the functional requirements of the design criteria and are consistent with the operating plans, procedures, and rules, Operations Criteria
- Assure that the systems elements (e.g., vehicle, power, control, communications, fare collection, surveillance) are mutually compatible. At the same time, assure that the facility elements (e.g., ROW, guideway, structures stations, maintenance, vehicle storage, and other permanent facilities) will accommodate the system elements
- Assure that the partitioning of the work in one set of documents matches the apportioning of work in the documents for adjacent and underlying work

4.7.3 Design Reviews

Design reviews are a vital element of the entire design management process and should be explicitly included in the design schedule. The smooth functioning of the design review process depends on reviewers' attitudes, diligence of observation, communications among disciplines, knowledge of project interfaces, and the skill of the project engineer in establishing the design review objectives. The purpose of the design reviews is to ensure:

- Quality and efficiency of the design
- Identification and corrections of errors and omissions
- Compliance with building, fire, ADA, and other relevant codes and regulations
- Meeting of operational and functional objectives

- Coordination among engineering disciplines
- Adherence of cost estimates to the budget
- Provision of timely feedback to designers
- Biddability, constructability, and cost-effectiveness of the design
- Interface compatibility with adjacent project elements and the existing transit system
- Compliance of the final construction contract documents with the design criteria, codes, regulations and the FTA determination relative to NEPA compliance (most likely via an ROD) for a MCP or NS project

The Integrated Master Project Schedule (as illustrated by a CPM network diagram) should contain the planned schedules for completion and review submissions at the specified levels of design for both consultant and in-house design. This design schedule requirement should be discussed during negotiations between the design consultant and the Project Sponsor, and should be included in the consultant's contract. All design management personnel having review responsibility must be aware of the finalized schedule and must be accountable for adherence to it. Design management should be focused on setting metrics to measure designer performance, setting priorities for design packaging, assisting in technical interpretations, and making scheduling adjustments until final acceptance of drawings and specifications.

Design reviews involve a formalized, structured approach to ensure that the reviews are comprehensive, objective, and properly documented. Reviews should include the Project Sponsor’s project personnel, consultants, and transit system operations and construction management staff to ensure that project objectives are met. Design review schedules must be maintained in order to meet established construction start dates and other program milestones. The basic steps to guide these reviews are:

- *Pre-submission review* – Before detailed reviews of design submissions are conducted, a pre-submission or onboard review of the Engineering documents should be performed to determine if the submission is likely to meet the terms of the design scope of work and to consider and bring final or preliminary closure on comments from any prior review. If the documentation for the submission is incomplete or does not represent what is requested for the upcoming submission, the project engineer should advise the engineering manager of the schedule impact and recommend appropriate action. The project engineer should then advise the internal design team or the design consultant of the submission discrepancies and indicate that corrective action be taken to maintain the design schedule.

- *Review process* – A distribution list should be prepared and used for providing copies of drawings and specifications for Project Sponsor and consultant reviews at the first, second, and third review stages. The Project Manager should conduct an audit against the contract scope(s) of work. The scopes of work for a design project should specify, at a minimum, design analysis documents, estimates, schedule issues, drawings, and specifications that are to be submitted at each design review level and the extent of completion of each.

- *Review of drawings* – Design reviews should ensure that the Project Sponsor concepts and criteria and the requirements of the environmental documents and third-party agreements are followed and should evaluate the adequacy of the design and drafting for the expected level of completion, clarity, economy, and format. Reviews should also determine whether the interfaces with adjacent and overlapping projects have been resolved and whether the design is complete, constructible, cost-effective, and compliant with established standards and variances granted to the design consultant.

- *Review of specifications* – Copies of the specifications appropriate for the level should be transmitted through the task leaders to the reviewers for technical review and comment.

- *Review comments* – The comments developed during a review of drawings, specifications, cost estimates, calculations, survey notes, and related items should be transmitted to the project engineer for consolidation, verification, review, and action. A standard form should be developed for the use of all reviewers documenting comments, response, and resolution.

- *Review meeting* – This meeting is to examine the pertinent review comments with the design consultant to ensure that any criticisms of the design are understood, that Project Sponsor inputs are provided, and that the contract documents can be satisfactorily revised and advanced to the next milestone and through to completion. The meeting(s) should be chaired by the project engineer and attended by the contract administrator, representatives of the tasks that provided review comments, systems planning personnel, and the consultant's designers representing the appropriate disciplines. Important to a project's ultimate success is the involvement of Project Sponsor departments (and Project Sponsor consultants, if used) that will have responsibility for the construction and O&M phases. Comments should be summarized by the project engineer and transmitted to the design consultant immediately thereafter.

- *Disposition of review comments* - A method should be devised by which actions taken by the engineer or design consultant in response to review comments are documented, and a record of those actions are provided to the original reviewer in order to bring satisfactory closure to all comments. Many Project Sponsors have implemented internet based tracking database systems that allow a consolidated review of all resolved and outstanding comments to facilitate managing the design review process.

4.7.3.1 *Initial Design Reviews*

As a minimum, the following submittals/reviews should be accomplished, based on the initial establishment of operating performance and facilities requirements, as discussed in earlier in this chapter.

- *In-Progress Preliminary Submittals* – These submittals are intended to facilitate an organizational review of the recommended approach, including evaluation of the rejected alternatives. As such, all factors affecting the recommendation must be addressed in the plans and/or design report.

  Utility conflicts (i.e., any conflict influencing project location or having cost and/or schedule impact) must be identified. Affected parties, including utility owners, railroads, government agencies, and private owners, should be listed. Deviations from the conceptual plans should be justified. Attempts to mitigate impacts discussed in the NEPA process must be stated and physical constraints on the project location should be identified. Economic comparison of discarded alternatives should be made.

- *Design Parameters Submittal* – This is meant to demonstrate that the approach to all major design concepts and features has been resolved and that can be initiated. As this submittal marks an important design milestone, it should:
  - Define the impact of construction on all affected parties including utilities, railroads, governmental agencies, commercial properties, residential areas, parks, etc. This should include an assessment of the effect of project labor requirements and construction work schedules on other construction work in the area.
  - Serve as a permanent record of design development and reflect the basic concurrence of all parties.
  - Define the scope of work for initiating detailed design of the project.
  - Provide a satisfactory basis for a realistic estimate of the cost of construction, which will serve as a budget.
  - Establish the project scope, or limits, with respect to ROW.

  Separate requirements should be established for the design submittals of the various disciplines, e.g., civil, structural, electrical, mechanical, architectural, and each system-wide element (trackwork, signals, traction power, Fare Collection, communications, revenue, and non-revenue vehicles, etc.). A design report should be included as part of the documentation of this submittal and as such should address and record the justification for, and analysis of, design requirements, methodologies, and the establishment of the Baseline Project Definition. Outline specifications and a preliminary construction cost estimate must be prepared. Though a cost estimate may be developed by the design group, this should be developed by estimators with construction and equipment/materials procurement expertise using accepted industry standards and be traceable to the design drawings and specifications in every respect. If an incompatibility with the budget exists and cannot be solved by application of VE or prioritized budget reductions, the original scope should be revised within the constraints of the Environmental Document.

  As indicated elsewhere in these *Guidelines*, the Project Sponsor for a Major Capital Projects will be required to submit a project budget using FTA's Standard Cost Category (SCC) format. Therefore, Project Sponsors would be wise to present cost estimating that is not only in conformance with a logical Work

Breakdown Structure (WBS) and utilizing such as the Construction Specifications Institute (CSI) format, but also correlating the same with the appropriate SCC line items. Beginning Engineering with this requirement will expedite the assembly of cost data for FTA.

4.7.3.2 *Completion of Engineering Reviews*

At least three major categories of design reviews should occur during the completion of Engineering. The exact degree of completion at each review might vary depending on the project or the project element. A final verification and delivery follow the three reviews and culminate in complete documents for construction and/or equipment/materials bidding. The scope of these reviews is as follows:

- *First Review* – The intent of this design review is two-fold. First, it must document the activities of the design team in reflecting on the Basis for Design (i.e., the Project Definition and supporting design analysis, cost estimate, contracting method and schedule documentation) plus any memoranda of understanding resulting from the NEPA process or FTA qualifications in its Record of Decision to resolve any changed conditions relative to design criteria. Secondly, this review should include updated design analysis reports, complete aerial and other topographic data, completion or at least considerable advance of geotechnical studies, real estate requirements and other investigations, updated cost estimate and Integrated Master Project Schedule, and firmly established policies, practices and procedures to ensure advancement of the project to design completion.

- *Second Review* – The purpose of this intermediate review is to ensure that all major features of design are progressing in accordance with prior direction, major engineering and architectural disciplines decisions have been made, and most drawings, specifications, and other documents are well advanced, and checked. The project cost estimate should be updated based on the advance in design and checked against the budget established for the project, and any cost problems resolved before proceeding to the next stage. This review should be rigorous and have as its goal the complete resolution of any outstanding issue so that detailed design and preparation of contracting documents can proceed with limited need for changes, and optimum effort expended on that work.

- *Third Review* – The construction drawings and specifications are to be essentially complete and again checked by the time of this submittal. Subsequent to this review, only incorporation of comments arising from this review, plus sign-off and approval should be required to complete these documents. A very extensive review is, therefore, necessary at this level since it is the last major design review. The cost estimate should also be verified against the budget established for this project.

- *Final Verification* – After delivery of all completed, signed, original drawings, those making review comments should verify that previous comments have been satisfactorily resolved and cost estimates are in line with budgets so that organizational or individual approvals can be given. Final delivery and acceptance of the completed documents is not to be considered an opportunity for conducting another design review. Further review comments at this point should be construed as a failure on the part of the reviewer to conduct proper reviews of the prior submissions. Moreover, further comments that do not pertain to the third review should not be considered unless the design is in error because of an unsafe condition, is not constructible as shown, or if new work that was not previously shown has been added. The reviewer and the project engineer must carefully evaluate comments made on this submission to gauge their necessity.

4.7.4 Construction Planning and Constructability Reviews

Construction planning and constructability reviews are highly recommended during the design process. Constructability reviews are typically thought of as a process whereby plans are reviewed by experts in construction techniques and materials to assess the buildability of the design. Construction planning is even broader in encompassing the environment and other pragmatic implementation conditions affecting upon the where, when, and how a design is to be built. They should be conducted in tandem and as part of establishing the design criteria and project standards (a broad brush review) and again but ever increasing level of exploration at the increasing levels of the Engineering design reviews to:

- Eliminate construction requirements that are impossible or impractical to build
- Maximize constructability, recognizing the availability and suitability of materials and specialized equipment, the capability and availability of labor resources by trades, and the standards of practice of the construction resources
- Verify accurate depictions of site conditions with regard to access, utilities, and general configuration
- Ensure adaptation of designed structures and features to site conditions and constraints
- Determine adequacy of work and storage space including contractor access to the site
- Determine appropriate construction durations and milestones
- Verify requirements for QA/QC
- Verify that safety and security requirements are appropriate for the particular construction site(s)
- Clearly define procedures for scheduling outages and the feasibility of utility interruptions
- Determine requirements for Project Sponsor-provided materials, equipment, services, and utility connections
- Assure that designs can be constructed using methods, materials, and equipment common to the construction industry
- Ensure attention to local community restrictions and accommodations and the requirements of the public, including existing transit patrons and persons with disabilities. The review should also assure that the project accounts for adjacent land uses and impacts
- Ensure coordination with operating elements of the existing transit system, if any

4.7.5 Peer Reviews

Peer Reviews (and VE, as discussed elsewhere in this chapter) can be used to provide an independent critique of the planning, operations considerations and design products. As the name implies, experienced individuals in the subject matter of the project (i.e., peers) are provided the necessary background documentation and asked to review and critique the approaches, findings, and decisions reached on any variety of topics relevant to the implementation of the project. These critiques are intended as independent input to the Project Sponsor on issues that present unique problems.

Topics of Peer Review have run the gamut from planning for operations, project financing, safety and security, contract packaging and contracting methods of delivery, engineering solutions to complex areas for design such as bridges or tunnels, O&M facilities, revenue vehicles, and just about any topic wherein an outside critique is desired. These are not normally either as robust or formal as VE exercises, and the level of detailed analysis usually is limited to concepts or functionality, with advice given more in a “lessons learned”, give-and-take critique, with reference to where or what to look for as additional Project Sponsor consideration on developing work plans or processes.
FTA encourages the Project Sponsor to confer with other transit operators and maintenance experts to benefit from their experiences. Learning from others has been used to review rail extensions and NS projects and in the planning of O&M facilities. The purpose of peer review is to improve the performance of the process or product being reviewed. Peer reviewers try to answer the question "Can we do this better?" Although the Project Sponsor is always encouraged to conduct a peer review of any capital project, in some instances, FTA may require it to do so.

Peer Review is a separate step in the design development process that can add an external perspective to enhance the quality of design, construction, and operation. FTA requires Peer Review for Small Starts and midsize (bus and/or rail) projects funded under the Section 5309 discretionary program; FTA strongly recommends it for bus facilities funded under other programs.

4.7.6 Value Engineering

4.7.6.1 *Definition and Requirements of Value Engineering*

FTA requires the use of VE techniques on all New and Small Starts transit construction projects. An FTA-sponsored study that provides guidance on VE is:

☞ Value Engineering Process Overview [Ref. 4-11].

Value Engineering (VE) is a systematic, multi-disciplined approach designed to optimize the value of each dollar spent. To accomplish this goal, an independent team of architects/engineers identifies, analyzes, and establishes a value for a function of an item or system. The objective of VE is to satisfy the required function at the lowest total cost (capital, operating, and maintenance) over the life of a project consistent with the requirements of performance, reliability, maintainability, safety, and esthetics.

4.7.6.2 *Timing of Value Engineering Studies*

The highest return on the VE effort can be expected when a VE workshop (or study) is performed early in the design process before major decisions have been completely incorporated into the design. VE should be performed at or near the completion of establishment of the design criteria and project standards before PD completion, and at each major design milestone thereafter. It should be noted, however, that proposed changes in design direction become potentially more costly and potentially schedule-disruptive as the design progresses, so heavy focus should be applied to VE during the earliest stages of design in compliance with the environmental document.

4.7.6.3 *The Value Engineering Workshop Team*

VE should be performed during a weeklong workshop by a multi-disciplined team of professionals who are not part of the design team and are specifically assembled for that purpose. Personnel might include electrical, mechanical, civil/structural, and construction engineers, as well as specialists in architecture, cost estimation, construction management, and transit O&M. Most, if not all, the participants should have experience in VE workshops, so that efficient use is made of the time allowed for the study. To the extent possible and warranted by the complexity of the project and/or the experience of the Project Sponsor on similar projects, the VE team should be assembled by and report to the Project Sponsor to best ensure its independence from the design team. There have been and will continue to be instances where the design firm (or team of firms) can provide VE team members who have no other role on the project but bring experience from other projects, and the Project Sponsor may wish to utilize such expertise to augment its VE efforts. The team facilitator should have extensive experience in conducting VE workshops or be a Certified Value Specialist (CVS).

4.7.6.4 *The Value Engineering Workshop*

As defined by SAVE International (formally the Society of American Value Engineers), the VE workshop typically consists of six phases:

- *Information Phase* – Obtain project information including design drawings, specifications, cost estimates, design criteria, imposed constraints, site conditions, utilities available, utility rates, and O&M practices. Receive a presentation by the designers on current status and visit the site. Review and validate cost information, calculate life cycle costs, and construct a cost model.

- *Function Analysis Phase* – Define the functions of the project, identify the cost and worth of each function, and determine areas of high cost and low worth. Analyze the project to understand and clarify the required functions.

- *Speculation/Creative Phase* – Generate a list of alternative methods of performing the functions involved in the targeted areas of the design.

- *Evaluation/Analysis Phase* – Evaluate each of the generated ideas against both functional requirements and cost-reduction objectives, as well as for feasibility and potential for acceptance by the Project Sponsor. Less promising alternatives should be screened out, leaving a small number to develop into full-fledged proposals.

- *Development/Recommendation Phase* – Develop a revised design for each proposed change. After drawing a sketch, estimate the initial capital and life cycle costs for both the original and proposed design and list the advantages and disadvantages of the proposed change. Hold consultations with the Project Sponsor and the design firm personnel to ensure that the proposed changes are based on the best information available.

- *Reporting/Presentation Phase* – At the end of the workshop, the VE team should meet with designated Project Sponsor staff members and design consultants to present the design, cost details and advantages/disadvantages of the recommended alternatives. Furnish written copies of all proposals for preliminary review by the Project Sponsor and its consultants.

Within two weeks of the workshop, the VE consultant should submit a draft VE Workshop Report to the Project Sponsor that should include the project background and description, the scope and methodology of the analyses, a summary of the VE Workshop recommendations, and details of each proposal with estimated costs, expected savings, and back-up documentation.

After the Project Sponsor makes timely final decisions on adoptions or rejections of the various proposals, the final VE report should be prepared. The Project Sponsor should consider reimbursing the project A&E for additional costs resulting from design enhancements due to VE. The Final Report should include a summary of accepted proposals with revised capital and implementation costs, as well as a list of rejected proposals and the reasons for their rejection. FTA may request an annual VE report that tracks the progress of VE efforts as the project moves forward.

4.7.7 Quality Assurance/Quality Control in Design

The QA program for design is encompassed in the general guidance on QA/QC presented in Section 3.7, which follows FTA's Quality Assurance and Quality Control Guidelines [Ref. 2-57]. The design document submittal, review meetings, and change control procedures, described in Section 4.7.3, ensure that project requirements will be met before continuing with subsequent tasks. QA/QC includes all activities to ensure that design requirements are understood, that design interfaces are coordinated, that design verification activities and reviews occur, and that design changes are controlled and documented. Any deviations from the configuration baseline should be justified in writing. The design calculations included in design submittals should be checked along with the drawings and specifications. Additional guidance on QA in the design process is available in:

☞ Quality in the Constructed Project [Ref. 4-11].

Quality assurance is oftentimes explained by the "Plan, Do, Check, Act" cycle fashioned by W. Edward Deming in the 1950s, as depicted in Figure 4-1.

Figure 4-1. "Plan, Do, Check, Act" Cycle

4.7.8 Design Management for Alternative Delivery Projects

4.7.8.1 *Design Review for Alternative Delivery Projects*

An alternative delivery method project will often require different approaches for Design Management. One of the major variations for any variation that includes D/B is that 100 percent design plans are not completed prior to the construction bid. The Engineering plans are completed to a 15-30 percent (typically) level and then procurement documents are prepared including the performance criteria that will dictate both design and construction requirements. Therefore, the Project Sponsor must review the design submissions based on compliance with design criteria. One of the most difficult adjustments can be that the design work is developed into packages that will allow the work to proceed. For example, the civil site packages are likely to be submitted for "release for construction" before any detailed design is seen. This would also be the case for any long-lead items that need to be ordered.

In order to meet stringent construction deadlines the design review approach is often "over the shoulder" where there is usually co-location between the Project Sponsor's team and the D/B contractor. The reviews often occur in a real-time environment that significantly reduces the comments and time required for processing the formal submissions. While specialty elements such as systems may vary, civil design submissions may be limited design review at preliminary and final stages.

4.7.8.2 *Value Engineering for Alternative Delivery Projects*

While a formal VE process can still provide the Project Sponsor with value for an alternative delivery project prior to the development of the procurement packages, often the entire procurement process can be considered to be an exercise in VE, as bidders seek to bring innovation to the table in the initial bid and will continue to do so as the design is developed. As long as this occurs within the parameters of the performance requirements, the contractor's VE process is not a formal interaction with the public owner. However, most D/B and similar agreements do include formal VE clauses wherein the contractor is permitted to recommend cost or time savings solutions that would require modifications to the agreement or the performance standards. If the Project Sponsor agrees to the solution, savings are then shared as specified in the governing contractual agreement.

CHAPTER 5 – MANAGING THE PROJECT DURING THE PROCUREMENT AND CONSTRUCTION PHASES

5.1 Introduction

During the Procurement and Construction (Procurement/Construction) Phase, outside contractors and/or Project Sponsor force account employees construct the fixed facilities, fabricate and install equipment, and integrate the facilities and equipment into a functioning system. The work is done in accordance with the plans and specifications developed during the Engineering Phase. The Procurement part of this phase encompasses equipment and materials procurement contracting, whether for “furnish” or “furnish and install” contracted equipment and materials.

Chapter 3 defined management principles and practices including the following that apply to more than one phase of the project development process:

- Project Sponsor and project management organization
- Financial requirements and resources
- Project scheduling
- Controlling costs
- Controlling project configuration and changes
- Risk assessment and management
- Safety and security certification (SSC) and hazard analysis
- Threat and vulnerability analysis and management
- Procurement and contracts
- QA and QC
- Project communications

As a supplement to the principles presented in Chapter 3, this chapter contains project management guidelines specifically related to the Procurement/Construction phase of a transit capital project.

5.2 Developing a Plan for Managing Construction

5.2.1 Organization and Staffing; Responsibilities and Authorities

Organizational Objectives

According to the report *Better Management of Major Underground Construction Projects* [Ref. 3-23], the most frequent cause of project disruption for any major transit project is "delayed decisive action." This conclusion is the same regardless of where the delays occur, and may be the major contributing factor in disputes, claims, cost overruns, and construction delays. The report continues:

Delays in resolving critical issues can usually be attributed to the way in which the decision-making process flows through the organization controlling the project. For that very reason, it is essential that an organizational structure be developed to ensure clear assignment of responsibilities and authorities and lines of communication from the first line supervisor to the top-most Project Sponsor decision-maker. These characteristics, when combined with complete written organizational procedures, become the "organizational objectives" for the project.

Project Sponsor's Organization

Prior to beginning construction, the Project Sponsor should have decided on a project management organization that will be responsible for moving the project from conception to completion. In larger projects, this may mean establishing a key management group that will:

- Have one lead manager within the group as the single point of contact for critical interfaces and directions.
- Be empowered to make decisions and take action.
- Be responsive to emergency or rapidly changing conditions.
- Perform progress reviews, quality assurance, and related actions.
- Track and be responsible for deliverables.
- Interface with external agencies.
- Function as a single point-of-contact with FTA.
- Be responsible for project accomplishment

Project Team Functions and Responsibilities

The size, composition, and functional responsibilities of a project team should evolve after detailed consideration of activities occurring throughout the project's life cycle. Consideration should be given to making use of existing technical personnel, managers, and professionals familiar with the project environment. Care should be exercised, however, to avoid overburdening those with responsibility for present operations. Additionally, the "project organization" should not be responsible for routine operations and maintenance of the existing system while trying to manage a complex construction project. Staffing the project organization with qualified professionals is essential.

5.2.1.1 *Interface Points*

Several interconnected functional relationships exist during the construction of a major transit project. One of the most difficult and time-consuming aspects of project management, termed *interface management*, entails:

- Companies involved as joint ventures and under contract
- Interface between or among functional elements of the organization
- Interface between or among locations
- Interface between or among project phases
- Interface between or among governmental, state, or local regulatory agencies
- Interface between or among private and other public interests

To enhance and establish interface management, the Project Sponsor should clearly define and enforce:

- Responsibility, authority, and accountability at each of the interfaces
- Inputs and outputs in terms of organization, function, and schedule
- Lines-of-communication

Appropriate Roles: Staff and Consultants

While a number of scenarios may describe the roles for Project Sponsor and consultant staff, all require clear definition of roles and responsibilities close cooperation among participants. All participants in the project must fully understand and accept that the Project Sponsor has ultimate and final responsibility for the project.

The staff, for its part, is an extension of the organizational responsibilities of the Project Sponsor's project manager. Staff organizations generally are configured to provide the greatest level of direct project support and control by delegation of authority and responsibility. Delegating project control as close to where the work is to be accomplished is encouraged, where practical. The staff is expected to communicate all project information to the project manager and the Project Sponsor organization. Project Sponsor should also avail itself of the consultant expertise. Cooperation among all these staffing elements will go a long way toward ensuring the successful completion of the project.

Consultants may perform one of two roles:

- Extend the Project Sponsor's staff by providing technical support and assistance.
- Serve as a direct representative of the Project Sponsor empowered to function in the role of project manager for the major portions of or the entire project.

Either of these roles relies on the Project Sponsor's staff and the consultant or his/her staff maintaining harmonious relations, which can best be achieved by having clearly defined each group's roles and responsibilities in all phases of the project.

Key Personnel

Project key personnel are individuals in leadership positions and those directly involved in the planning and execution of the project. They may range from the Project Sponsor's principal representative down to and including the resident engineer (RE). Consultants may also be defined as key personnel, depending on the tasks assigned to them.

Project Sponsors must identify key organization and consultant personnel, and assign responsibility and authority as necessary. Project Sponsors must also identify key personnel in the contractor's organization, including the corporate officer-in-charge.

5.2.1.2 *Relationship to Project Delivery Method Used*

During Procurement and Construction, the Project Sponsor's technical means and methods, organization, and staffing directly relate to the type of contract by which equipment procurement and/or construction is authorized. For a traditional design/bid/build (D/B/B) project delivery, the Project Sponsor (staff and consultants) team holds responsibility for procuring and coordinating the activities of one or more construction contractors or equipment suppliers, and therefore has sole project management responsibility for functions including:

- Construction safety and security oversight
- Contractor integration and coordination
- Designer interface and support
- Construction supervision and inspection
- Utilities interfaces with construction
- Systems integration and testing
- Project schedule control
- QA
- Interface with the existing transportation systems, including operating railroads and other operating modes
- Coordination with existing transit operations
- Project cost control
- Community relations
- Public information including media relations

With alternative project delivery methods, some of the Project Sponsor responsibilities are assigned to the contractor, necessitating changes in organizational structure and staffing. For methods that combine design and construction for the entire project, the Project Sponsor's role may evolve to only oversight of the contractor. In general, alternative project delivery methods would give the contractor a greater role in the functions toward the top of the above list. Whatever the contractor's roles, it must always be understood that the Project Sponsor retains final authority over the project. It is important not to delegate to the contractor responsibilities that the contractor cannot ultimately execute due to lack of authority i.e., third-party agreements.

Understanding the Project Sponsor's role and responsibilities as a management function, rather than an adversarial and dictatorial one, is an important distinction in non-traditional delivery methods. It becomes the Project Sponsor's job to articulate to the selected team members each person's or committee's organizational functions and responsibilities, the reporting requirements of the contractor, and the public accountability responsibility of the entire team.

The Project Sponsor should have sole responsibility for certain functions, such as public funding, government liaison, property acquisition, agency agreements, and assessing environmental impacts. The private sector, for example, the Design/Build/Operate/Maintain (D/B/O/M) contractor, can provide a different set of capabilities and resources, depending on what each is being asked to perform or accomplish. The private sector can offer new ideas and innovative solutions to various aspects of the project, and have the monetary incentive to manage certain risks more effectively than the Project Sponsor.

5.2.1.3 *Construction Manager Approach*

The construction manager (CM) approach to project management during the pre-construction and Construction/Procurement Phases has been found to offer a high likelihood of project success. The CM is responsible assuring contractors comply with the contract and for project construction and certain equipment and material procurement administration from start of construction to the final turnover to the operations and maintenance (O&M) personnel. Where responsibilities for related activities are under the control of other jurisdictions, the CM is responsible for integration and coordination of those activities.

Prior to contract award pre-construction phase, the CM is responsible for verification that the contract milestones are compatible with the Integrated Master Project Schedule (IMPS), special construction requirements, constructability reviews, and participation in VE studies. During construction, the CM is responsible for monitoring contract compliance with the drawings, specifications, and other requirements including construction warrantees, contract documentation and as-built record, affirmative action and EEO, DBE participation, and contract closeout. Additionally, the CM is responsible for overseeing contract administration procedures and construction safety and security. The CM provides construction management personnel to supplement the Project Sponsor's CM organization.

5.2.1.4 *Design/Build Approach*

Project Sponsors are employing alternative project delivery systems with increasing frequency. One of the most common of these is the Design/Build (D/B) approach, or fast-track construction. Under this approach, the Project Sponsor issues a single contract for the design and construction of the project, based on a high-level description and set of documents. The D/B contractor will typically comprise a team of designers and contractors who prepare a detailed design conforming to the high-level Project Sponsor documents. The Project Sponsor has the opportunity to review and approve detailed designs, but limited ability to reject designs that conform to the documents, without incurring additional costs. The advantage to this approach is that the resolution of conflicts between the design and contractor lies with the D/B team. In addition, the contractor can start construction much earlier in the project delivery process, leading to improved performance times.

Under the D/B approach, the Project Sponsor controls overall project management, oversight, third-party agreements, and other tasks needed, for which risk cannot be transferred to contractor, to deliver the final project.

5.2.1.5 *Resident Engineer*

A qualified RE should be assigned on a full time basis by the CM for the larger construction contract. The RE will assume responsibility for administration of the contract once award is made. The RE is the Project Sponsor's primary field representative, and is the contractor's single point of contact. The RE receives all submittals, requests for information (RFIs), correspondence, and change order requests. The RE ensures that the work is constructed in accordance with the requirements of the drawings and specifications throughout the project up to and including final inspection, testing, and closeout.

Work to be done under any contract will not be considered complete until it has passed a final inspection by the RE and the Project Sponsor. The contractor must carry out the instructions of the RE insofar as they concern the work to be done under the contract within the RE's limit of authorization. The RE has the authority to direct that unacceptable work be halted and removed and replaced at the contractor's expense.

Approval by the RE signifies favorable opinion and qualified consent. It does not carry with it certification, assurance of completeness or quality, or accuracy concerning details, dimensions, or quantities. The RE's approval will not relieve the contractor from responsibilities for error, improper fabrication, and non-compliance to a requirement, or for deficiencies within the contractor's control.

5.2.2 Project Labor Agreements (PLAs)

During construction planning, careful examination of the existing labor situation is essential to determine the impacts of:

- Labor organizations
- DBE participation
- Local labor situation
- Contractor labor practices
- Davis-Bacon wage rates

Each of these areas will have an impact on the project if not fully evaluated and considered in the Project Management Plan (PMP) and, in turn, captured in the analysis of project costs and scheduling.

Local PLAs are a means of preventing disruptions or disagreements over the way in which the project is managed and staffed. PLAs may extend among the Project Sponsor, contractors, and unions. All PLAs should be approached with caution to ensure that the agreed to actions are enforceable and in compliance with accepted laws and procedures. When allowed, PLAs are usually negotiated by the Project Sponsor with relevant labor organizations. Because this process can be very lengthy, the Project Sponsor should start it well in advance of contractor procurement so that the terms of the PLA reflected in the solicitation documents when first released. Once negotiated, the PLA is put into the construction contract so that the bidders know that they must enter into a PLA and so they know the terms of the PLA before they decide to submit their bid. PLAs, which historically have helped to minimize labor staffing and wage and benefits disagreements that may lead to work disruptions, usually involve the following:

- Negotiating between the contractor and labor unions wages and work rules that supersede existing collective bargaining agreements
- Providing union scale wages and benefits and prohibiting strikes and lockouts
- Binding of all contractors and their subcontractors by the agreement according to the terms of their contracts

PLAs were disallowed by two 2001 Executive Orders (Nos. 13202 and 13208), and those Orders were repealed and replaced by another Executive Order (No. 13502) in 2009 which now encourages the use of PLAs. Project Sponsors should stay abreast of this topic.

5.2.3 Interface with Utilities

The Project Sponsor should establish master agreements with all affected utilities during the PD Phase and develop specific agreements with those utilities during the Engineering Phase and prior to FFGA or SSGA approval. These agreements should reflect the Project Sponsor's plan for assigning responsibility for the design of the new/relocated utilities, how long the design work will take and how long the actual construction/relocation will take. This scope should be accounted for in the schedule and cost estimate. Utility master agreements should contain language requiring the utilities to comply with FTA Buy America requirements. This issue should be raised early with all utilities because it can have significant consequences for the time, schedule, and technical features of this element. During construction, contractors must coordinate utility relocation and project service requirements with their overall schedule and aggressively manage the interfaces to avoid delay to the overall project. The Project Sponsor and its in-house or consultant CM also have responsibility to assist the contractor with such interfaces.

Certain property acquisitions may also involve securing replacement ROW way for utility relocations. Ideally, all real property interests and obstacles necessary for the project will have been acquired, controlled, and cleared by the time construction begins on a project. To the extent that that is not the case, construction contract specifications must address the availability of such areas in the context of:

- Release dates for certain real estate parcels as acquisition or relocation is incomplete
- Work-arounds or “hold-off areas” as specified
- Demolition or clearing of existing site improvements
- Remediation of contamination
- Access restrictions or maintenance requirements for certain parcels

Theoretically, any additional work elements or restrictions included in the construction contracts may (and likely will) result in a proportionate increase in cost. In some situations, however, the inclusion of certain demolition or clearance activities in the construction contract may be the most efficient way to deal with such items.

Restrictions of contractor access or activity within the project limits because necessary property rights have not been acquired will usually result in increased cost of construction and may cause a delay in delivery of the project. To reduce the likelihood of these outcomes, Project Sponsors should emphasize coordination of the real estate acquisition and construction schedules from the onset of the project. In the risk assessment that is undertaken for a transit project, this risk of schedule delay and the potential consequent increase in cost must be continually monitored to preclude it from occurring.

Project Sponsors must carefully monitor project milestones, including real estate procurement and clearance, to ensure compatibility with the Integrated Master Project Schedule (IMPS). Providing a controlled and cleared ROW for the construction of the project in accordance with the approved scope (design plans and construction specifications) helps to ensure adherence to cost and schedule parameters.

In some cases, a utility must be relocated before the start of other construction work. For this reason, many agencies use pre-award authority for utility work to accomplish site preparation, utility relocation, and restorations prior to awarding a larger line, trackwork, or systems contract.

5.2.4 Interface with Transit Operations

Capital projects involving modifications or extensions to an existing transit system must be sensitive to the requirement for the continuity of transit O&M activities in a safe and secure manner for all customers, employees, and the public. Construction contracts should include such requirements and define the contractually acceptable-to-Project Sponsor amount of deviation or delays to normal transit operations by time of day, day of the week and specific calendar date(s). Contractors may be required to submit interface plans through the RE for the approval of the transit operating department.

Project Sponsor force account support may be required to complement the construction activities of contractors. Support could include providing flagging operations, work trains, bus bridges when there are outages of the fixed guideway system, and interim facility (e.g., track, signals, traction power, communications, and control center) modifications to support construction activities. Transit operating personnel must be informed of construction activities on or adjacent to the operating system. Such notices may include slow orders to maintain safe operations. The contract documents should specify the cost (if any) of any force account support, including service outages, arrangements, time and consequences. For example, the Project Sponsor can include a liquidated damage provision for failure to return track to service by a certain time. It is important that any liquidated damage provision be supported by an internal, but fully documented, basis of calculation, so that damages do not become an unenforceable penalty.

The contractor should be responsible for limiting access to the construction site while maintaining adequate access for the transit riders and the public. Signage, markings, lighting, walking surfaces, and railings must be designed, installed, and maintained to support the continuity of safe and secure transit operations. Project Sponsor oversight of the contractor's efforts in this regard is important, and the Project Sponsor should make certain that all bid documents and contracts specify that a designated RE (either Project Sponsor staff or a consultant) has the authority to issue stop orders or to temporarily halt contractor activities if the construction site is not properly maintained.

Transit Operations should be an integral member of the project team from early project development through construction, testing, and turnover to operations. Transit operations will be increasingly involved in the project as it gets closer to completion. Chapter 6 addresses the Testing and Start-Up Phase, during which transit O&M forces should be actively involved.

5.2.5 Community Relations and Public Information

One of the most essential requirements for managing large, costly, and visible transit projects is to ensure that public perceptions of the various activities are positive and well informed. Major transit construction projects are, by their very nature, highly visible and generally a cause for considerable public scrutiny. In addition to the public, numerous Federal, state, local, and private organizations share common interests in projects of this type; each requires information regarding various aspects of the project.

Managing relationships with these diverse groups is essential to ensure that perceptions of the project are factual and positive, and that information is readily and continuously available. Key project personnel and staff members, particularly in the public relations area, play a major role in providing information and correcting any misperceptions that exist about the project within external organizations or among the public. The PMP must include a section on the project's public involvement program, including the following, as appropriate:

- A strategic public relations program including, for example, providing "Open for Business" signage and driveways access during construction
- Community relations programs
- Guidelines for the release of project information
- Workforce information programs and grievance procedures
- Internal lines of communication for project issues
- Procedures for quickly responding to external information needs
- Scheduled meetings and forums for the workforce, external organizations, and groups to establish effective two-way communications throughout the life of the project

See Chapter 3 for additional guidance related to project communications. During the previous phases of the project, the various groups and agencies affected by the project should have been identified. By the construction phase, a comprehensive communications program should have been established to address public concerns during construction.

As the project progresses and reaches the Procurement/Construction phase, public concerns will be raised, making frequent, factual, and open dialogue on the details of construction activities even more imperative. These sessions should be conducted as close to the actual construction site as possible to encourage public participation and to assure local awareness. The intent is to present an open forum for discussion and public involvement in the decision-making process.

The PMP's separate section devoted to external communications provides the Project Sponsor's policy and plan for how communications will occur and what authority levels are required for release of project-specific information. If the contractor has a separate public information office in addition to the Project Sponsor's, oversight and approvals should be required by the Project Sponsor prior to any release by the contractor's staff. The types of information the contractor may release without prior approval should be defined by the Project Sponsor, and may include:

- Routine non-controversial project information
- Awards and recognition
- Information not related to the project or the Project Sponsor

The Project Sponsor should coordinate its project schedule and types of construction work with other local agencies as part of construction planning early in the Engineering Phase. One potential advantage in doing so, especially for transit-related work in or along roadways, is coupling the work of the different agencies and so avoiding interrupting traffic (vehicular and pedestrian) and/or property access twice in a short time span. Cost savings may accrue as well, from either the increased size of the work to be bid or possible cost sharing with another agency. Coordinated construction, particularly in high density or busy public spaces, can improve local relations, too.

5.2.6 Quality Assurance/Quality Control

In the Construction Phase, the Quality Program objective should be to verify that equipment and materials installed, as well as work performed, comply in all respects with the contract specifications. As such, the Quality Program must provide an effective means to ensure that:

- Selected equipment is tested throughout development, manufacture, and installation to verify that it functions as specified. Test equipment should be properly calibrated.
- Work processes are controlled to ensure that work is done in the appropriate sequence, that the production and installation processes that directly affect quality are performed under controlled conditions, and that special processes that cannot be verified by subsequent inspection and testing of the product are appropriately monitored.
- Early detection of nonconforming conditions is accomplished, and positive corrective action is performed in a timely manner.

- Control over the configuration is maintained at all times to ensure the acceptability of equipment, as designed and contracted for, per approved drawings and accepted design verification testing.

The Quality Program should provide documentation so that the work can be accepted. It should also require the contractor to have an effective QC program and provide for the oversight of that program through the Project Sponsor’s QA activities. For non-traditional contracts, the contractor may be given both QC and QA responsibilities; nevertheless, the Project Sponsor must provide oversight of the contractor’s quality activities. See Section 3.7 and the FTA Quality Management Systems Guidelines (FTA-PA-27-5194-12.1) for additional guidance.

In addition to construction work, the Project Sponsor must also assure the quality of rolling stock. This work is required by FTA under the provisions of Section 12(j) of the Federal Transit Act. Specifically, the FTA requires pre-award and post-delivery audits for buses and rail vehicles. To meet the FTA’s requirements, the Project Sponsor must perform work-in-process and first article inspections because of the great expense, complexity, and long lead times for rolling stock procurements. Guidance for meeting this requirement can be found in the FTA resource:

☞ Conducting Pre-Award and Post-Delivery Audits for Rolling Stock Procurements, FTA DC-90-7713-93-1, Revision C, February 20, 2015 (Draft) [Ref. 2-8]

To meet FTA requirements, a Project Sponsor must:

- Complete visual inspections and testing to demonstrate that the vehicles meet the contract specifications.
- Send a resident inspector to the manufacturer's production facility during the final assembly period for procurement of rail vehicles or more than ten buses. The inspector must monitor the final assembly process and complete a final report describing the construction activities and explaining how the construction and operation of the vehicles fulfill the contract specifications.

The Project Sponsor's records should include copies of QC measurements, road and performance test sheets, and visual inspection sheets. The records should also include an analysis of manufacturing capability and an explanation of how the transit vehicles fulfill the contract specifications.

5.2.7 Change Control and Management

Changes during the Construction Phase could result from, but not be limited to, the following causes:

- *Differing site conditions* – Including:
  - Subsurface conditions different from contract representations (Type I)
  - Unknown or unusual conditions not reasonably anticipated (Type II)
  - Conditions created by previous contractors

- *Errors or omissions in plans and specifications* – The Project Sponsor should have an “errors and omissions clause” in the designer’s contract, and this clause needs to be strong enough, i.e., insurance level, to recoup losses resulting from faulty designs. The Project Sponsor may obtain compensation through the designer’s E&O insurance when a change required by an error or omission has a substantial monetary impact.

- *Value Engineering* – In addition to VE studies discussed in Chapter 4, construction contract language should permit contractors to recommend changes that could save capital costs or life cycle costs for the Project Sponsor. Such a clause is typically referred as a Value Engineering Change Proposal (VECP) clause. Cost savings associated with acceptable changes due to a VECP recommendation are typically shared 50-50 between the Project Sponsor and the contractor; some have 60-contractor/40-Project Sponsor sharing percentages to encourage VE where complex and/or relatively new design is being implemented. While the contractor is responsible for the engineering to support changes resulting from VE, the contract documents should establish a minimum value of savings expected to accrue to the Project Sponsor to both compensate for the Project Sponsor’s costs of processing and evaluation and discourage frivolous VE change proposals.

- *Project Sponsor action* – Including:
  - Changing portions of the plans and specifications
  - Altering the time allowed to perform the work
  - Changing the contractor’s method of work
  - Stop orders
  - Regulatory changes, such as environmental, security, and safety

Diligence during the planning and design phases of a project can reduce the risk of changes during construction. When changes do occur, it is necessary to give notice of the proposed change including all facts and costs in writing as quickly as possible to permit a cost-effective decision to be made. The Project Sponsor should have a Change Control process and applicable form wherein the source of the change is identified. Since oversight staff may be reticent to acknowledge errors or omissions as the cause of a change, the form may help to encourage them to make that designation when justified. The contractor should be given official notice either through a change order or by direction of the Project Sponsor or its agent, the RE. Documentation should provide back-up to the directed change.

No matter the size of the change, its impact should be assessed in terms of time and cost (estimated or actual). FTA’s Best Practices Procurement Manual [Ref. 2-22], Chapter 9, provides guidance in this regard. Establishing merit, preparing an independent cost estimate (cost/price analysis) before negotiations and property documenting the record of negotiations are key requirements for change order evaluation. The construction contract should address the process of pricing changes consistent with FTA requirements regarding issues such as equipment rates, overhead, and profit. This matter is one that accentuates the need for the inspectors to maintain careful diaries that identify environmental, labor, equipment, materials, and activities and durations at the site every workday. These diaries will be indispensable during assessment and negotiation of change orders or owner-directed changes. At the same time, diaries should provide assessments of the execution of work each day to forewarn of potential contractor claims that may surface, as well as to aid in preparing contract estimates to (at) complete(ion).

5.2.8 Configuration Management

In the Procurement/Construction Phase, the objective is to implement the project in accordance with the plans and specifications of the contract documents. Specific considerations during construction should include:

- Protection or relocation, as required, of existing utilities based on identification and design conducted earlier
- Requirement that construction contractors should verify existing site conditions and dimensions
- Sensitivity during construction to potential impacts from air, noise and water pollution, drainage issues (surface and sewers), archeological concerns and habitat destruction as identified in the final environmental document and associated mitigation requirements

In the Procurement/Construction phase, the project definition technical baseline established during Engineering will be used to monitor construction and fabrication processes. The baseline must be closely followed to ensure quality, safety, security, performance, and cost compliance. When changes are required, all changes to the project definition baseline must be reviewed and assessed by the technical experts, inclusive of schedule and estimating expertise, and then reviewed and approved by the responsible individuals as set forth in the PMP for the Procurement/Construction Phase.

During the Procurement/Construction phase, special emphasis should be placed on recording and documenting any changes that are approved and completed. Changes become a matter of official record and must be requested in writing in accordance with the project Change Control procedures before being considered for approval. The Project Sponsor must identify in writing those individuals authorized to approve equipment procurement and/or construction changes and the dollar thresholds of their authority. At the completion of equipment procurement (and installation) and construction, detailed equipment drawings, operating manuals, warranties, etc., must be submitted, and "as-built" drawings for constructed facilities must be prepared.

Design service during construction is the provision of designer reviews of contractor submissions, where submission requirements are detailed in the contract documents. These submissions include shop and working drawings, materials and equipment cut sheets, submittals required by Contract Data Requirements Lists (CDRLs), and testing for systems contracts. Where designer review and approvals are required, it is vital to adhere to the Change Control procedures, keep detailed records, and have established levels of authority (cost, functionality, and schedule impact) delineated for approvals, especially for any changes to the baseline.

Configuration management is especially important where an existing operating transit system is being modified. The configuration of the existing system is considered to be the project definition baseline; any modifications should be carefully designed to maintain or achieve the desired functionality; the proposed changes should have to be approved by the appropriate Project Sponsor managers including engineering, operations, maintenance and system safety; and the implemented changes should be carefully and completely documented to aid in future training, inspection and maintenance activities.

5.2.9 Delays

A delay is defined as a measure of the lack of progress against how the work was scheduled to progress to completion. Project delays can only occur if critical path activities are delayed. Delays on other paths consume float and do not result in a project delay until they consume all float, at which point they become critical. Delays to the critical path provide float to other, non-critical paths. Typical causes of delays include additional work, disrupted work, suspended work, or slow progress.

Delays are categorized as excusable or non-excusable. An excusable delay is unforeseeable and not within the contractor’s control (e.g., a natural disaster). It can be either non-compensable (the contractor receives a time extension but no compensation for the delay) or compensable (the contractor receives both a time extension and compensation for the delay). A non-excusable delay is one that is considered to be either foreseeable by the contractor or within the contractor’s control. For a non-excusable delay, the contractor receives no time and no compensation, and could be liable for actual or liquidated damages.

The contract should define appropriate examples of all these terms. There could also be concurrent delays due to the actions of both the Project Sponsor and the contractor, or by one contractor that affects another contractor. A critical path management (CPM) schedule for each construction and equipment/materials contract is essential and invaluable in evaluating the impact of an actual delay or a potential change.

Many Project Sponsors take the position that there should be no damages for delay. This means that the Project Sponsor is willing to give a time extension, but no financial compensation. The disadvantage with a no-damage-for-delay clause in a contract is that it causes contractors to add their estimated cost for the potential loss of compensation in their bid prices.

5.2.10 Claims Avoidance and Management

The general discussion of claims management in Chapter 3 has strong relevance to the Construction phase. Claims avoidance involves the process necessary to reduce the incidence of claims on construction projects. The techniques described in the following sub-sections can be applied to act both independently and collectively to reduce claims. The most important factors, however, are solid contract documents (with complete and accurate drawings, specifications and Terms and Conditions or General requirements) and maintenance of regular candid communications between the Project Sponsor and contractor to address problems as they arise. The goal should be to close out every contract with no outstanding claims that would remain to face litigation and increase uncertainty of the final project cost.

5.2.10.1 *Dispute Resolution*

A dispute occurs when the parties to a contract cannot agree on the interpretation of contractual conditions. A claim may be submitted by either party when the dispute cannot be resolved. The goal of the project organization should be to avoid disputes and claims through a process of planning and development that results in effective contract documents and procedures. The responsibility for understanding and instituting procedures for minimizing disputes rests at all levels within the project management hierarchy. Examples of actions by Project Sponsors that may lead to disputes include:

- Lack of full disclosure of geotechnical information
- Changing plans or specifications during construction
- Inadequacy of bidding information
- Inadequate time in the procurement process for bid preparation
- Vague or misleading requirements
- Improper denial of a change request that includes a request for a time extension
- Community, third-party agreement, utilities and permitting issues

Construction contracts should include procedures for responding to disputes that arise between contractors and the Project Sponsor. There must also be procedures that permit construction operations to proceed, if prudent, while disputes are reviewed and settled. The legal staff must also ensure that contractual documents have been well written and include specific provisions for resolving disputes in a timely manner and at the lowest administrative level possible.

Procedures for dispute resolution should be clearly defined in the contract. The selection of formal dispute resolution procedures should be a function of project size and the Project Sponsor's resources. Common dispute resolution procedures include:

- *Negotiation* – This is how the majority of claims are settled. It is the least expensive and quickest method of resolution.

- *Mediation* - A mediator generally is selected by the involved parties after a dispute has arisen. The mediator’s function is to provide an atmosphere in which the parties themselves can resolve the dispute. A mediator may make non-binding recommendations for settlement. Mediation offers informality and the good offices of an independent third party. This method lacks finality and may prolong the time required for ultimate resolution because the mediator's recommendations are not binding.

- *Arbitration* – Arbitrators generally are appointed after a dispute has arisen. Procedures for their appointment and the conduct of hearings are governed by contract, which may incorporate the rules of the American Arbitration Association, and by applicable statutes. The decision of the arbitrators is final and binding on the parties. The advantage of arbitration is considered the independent expertise and impartiality of the arbitrator. In most states, there is no right of pretrial disclosure and arbitrators are not bound by rules of law. In addition, there is no right of appeal on the merits, only for substantial procedural deficiencies. Arbitration has become nearly as expensive and time consuming as litigation.

- *Dispute Review Board (DRB)* – This is a board of third parties selected by the Project Sponsor and contractor when entering into the contract. As the work proceeds, the board meets periodically to review progress and incipient problems. The board, which is intended to have a deterrent effect, may serve as an arbitrator or only a mediator, as set forth in the contract documents. Establishing a DRB with ongoing responsibility through the life of a project is an innovative means of dispute avoidance and resolution. Cost considerations may make it practical for use only for very large projects.

- *Litigation* – Litigation is the most costly and time-consuming method of resolving disputes by taking a matter to court. In some cases, a jury may be demanded as a matter of right. Judges generally are not specialists since construction cases are relatively few in number as compared with other types of civil law cases. Litigation deprives the parties of the opportunity to have the facts evaluated by an individual with independent expertise. It offers procedural safeguards, however, such as pretrial disclosure and the right of appeal, generally not available in other dispute resolution procedures. Generally, because of its monetary and time costs, it is viewed as the least desirable approach to resolving disputes. Most of the other procedures described were devised as ways to avoid litigation.

Disputes can be avoided if anticipated problems are dealt with in the framework of contract documents. The recognition and elimination of contract elements that are vulnerable to change and misinterpretation can help stem disagreements. Clauses dealing clearly with changed conditions and quantity variations should be included in the contract document. In general, disclaimers and language that avoids responsibility should be omitted.

The PMP should stress that the sections on inspections, scheduling, QA, and others are intended as preventive procedures for early identification of potential disputes. The PMP should also define actions to be taken to document contractor performance.

Two documents developed by professional organizations that address construction disputes can provide additional guidance to Project Sponsors:

☞ Avoiding and Resolving Disputes in Underground Construction: Successful Practices and Guidelines [Ref. 3-31]
☞ *An Overview of Alternate Dispute Resolution for the Construction Industry* [Ref. 5-1]

In addition to contract language to mitigate disputes, other mechanisms exist to avoid or assist in settling disputes. One example is the requirement for Escrowed Bid Documents (e.g., Schedule of Values) from construction bidders, which allows a Project Sponsor to have detailed pricing backup by contractors should a dispute arise. This can provide the Project Sponsor with the assumptions and calculations supporting the contractor's bid that could be used to negotiate a change order or claim if there is disagreement. It can often work to the advantage of a contractor if there is an error or discrepancy in their bid calculations.

Avoiding Litigation in Construction

Partnering relationships between Project Sponsors and contractors can help to avoid litigation by solving problems as soon as they are uncovered. Project Sponsors are encouraged to keep detailed records on the cost of litigation in construction to provide a baseline for measuring future savings.

5.2.10.2 *Partnering*

Partnering was addressed in Chapter 3 as a general risk management tool. During the Procurement/Construction Phase, partnering can help avoid disputes and aids in resolving those that occur. Immediately prior to and during this phase the Project Sponsor should have partnering workshops at the beginning of each major contract for the project. Participation should involve primary project stakeholders including representatives of the Project Sponsor, contractor, subcontractors, suppliers, government agencies, designers, local police, business organizations, and others as necessary. The workshop sessions should focus on goal setting, and identify cross-functional requirements and expectations for a successful contract completion. At least one additional partnering workshop should be scheduled after the contract is well underway, perhaps after the accomplishment of a major milestone.

The U.S. Army Corps of Engineers has published a helpful pamphlet providing guidance on partnering:

☞ Partnering: A Tool for USACE Engineering, Construction and Operations, IWR Pamphlet 91-ARD-P-4 [Ref. 5-2]

5.2.11 Documentation (Progress Reporting, Maintenance of Records)

The PMP should establish internal reporting mechanisms and develop any special management plans. One such plan is a Construction Management Plan, which should provide manuals for the RE and Inspectors. The plan should contain detailed information for communications and should include reporting procedures and requirements for the following:

- Daily work schedules and progress reports
- Construction and fabrication status
- Materials status reporting/materials shortages

- Accident reporting and emergencies
- Security breach policies and reporting mechanisms
- Delays
- Stoppages
- Daily costs and expenditures for changed work
- Grievance procedures
- Project manager, REs, inspector reporting procedures
- Quality assurance and quality control
- Equipment and resource status
- External factors affecting the project

The areas listed above, and others, reflect the daily and periodic communications responsibilities of the project team, who must in turn communicate with the Project Sponsor or representative of the Project Sponsor. Each Project Sponsor must decide how much information is enough to keep the organization fully informed without overburdening the project team. This balance must be carefully weighed before the start of construction and changes kept to a minimum, with exceptions handled on a case-by-case basis.

Progress reports should be submitted monthly by the Construction Manager and should generally include the following:

- Milestone summary schedule and cash flow payment curve
- Current approved submittal schedule
- Fiscal summary for contract and major subcontracts (award amount, executed change orders, current commitment, payment dates, percentage expended, actual expenditures versus baseline cash flow, potential claims, and value of executed change orders)
- Potential change orders, including the description, status, and estimated cost and time impact of changes contemplated and not yet resolved
- Executed change orders, including the description, status, and settled cost and time impact, as well as outstanding issues not resolved in the change order
- Claims status, including the description, status, and outstanding issues
- A one-month look ahead narrative
- Systems design status by major milestone
- Facilities construction status by major milestone
- Procurement status
- Systems procurement/installation status by major milestone
- Integrated testing status by major milestone
- Submittals/deliverables status per the contract terms, and, at least, by major milestone
- Quality assurance/quality control status including test schedule/status, non-conformance status and actions taken, and audits scheduled/completed and significant findings

- Environmental mitigation status including compliance/non-compliance reports, completed mitigation efforts, public complaints, non-compliance issues raised by regulatory/oversight agencies, and hazardous material status
- Construction safety status, including reportable accidents, training, and other relevant safety information
- Construction security status, including any breaches, particularly those resulting in injury to employees, significant losses due to theft, or crimes against the site or surrounding area
- Photos showing recent progress
- Disadvantaged business enterprise status by subcontractor, including last payment time and amount, amount paid to date, original subcontract value, and change orders
- Permit application report, including the status and expiration dates of those obtained by the Project Sponsor and those obtained by the contractor, and permit modifications
- Coordination with other contracts, including meetings and written communications
- Utility work status by major utility
- Extra work
- Status of other activities including significant events, public affairs, and insurance

A number of the types of communications listed above are systems within themselves and are routinely used during all construction projects to report progress and status of various aspects of the project. The majority of these will have already been established by the contractor and are necessary for controlling construction. The Project Sponsor should first determine the reporting system(s) to be used by contractors, specify it (them) in the contract bid documents and awarded contract, and then determine what additional information is needed to keep all relevant internal and external groups fully informed. Two of the more important reports the Project Sponsor will want to receive frequently will be the summary of project costs and construction (project) progress.

External reporting requirements generated by outside agencies should be factored into the overall reporting system and used to develop a comprehensive list of information that is used by the Project Sponsor's organization, the contractor, and other organizations assisting the Project Sponsor.

5.2.12 Contractor Payments

The basis for contractor payments must be clearly defined in the contract documents. It should be closely related to the contractor’s pricing as reflected in the bid documents. Where unit pricing predominates, payment based on the number of units accomplished is appropriate, but most transit projects are much more complex.

A method that has been used with increasing popularity is the cost-loaded CPM. An early deliverable requirement of the contractor is a detailed CPM schedule, with costs assigned to each activity. The Project Sponsor must review and approve the cost-loaded schedule, based on the bid received from the successful contractor. The Project Sponsor would be wise to structure the bid sheets to obtain cost breakdowns that can later be compared to the contractor's cost-loaded CPM. Thus, payment can be directly tied to the accomplishment of construction activity. For short-duration activities, a single payment might be appropriate. For longer-term activities, progress payments might be more suitable, as long as they are based on easily measured, performance-based criteria.

It is highly recommended that the contractor be required to maintain an approved job cost account system to capture the costs necessary to demonstrate entitlement under various remedy-granting clauses of the contract, including costs for claims. Presented properly, this is beneficial to both the Project Sponsor and the contractor.

The Project Sponsor's organization must have a clearly established process for reviewing and approving contractor invoices to permit prompt contractor payment or the identification and resolution of any anomalies.

5.2.13 Project Closeout

The construction contract documents should set forth the process for project closeout. It should mandate that all contractor requirements be accomplished in compliance with contract specifications and include items such as, but not limited to:

- O&M documentation (manuals) and training
- Completion of punch list items
- Final inspection by the Project Sponsor
- Warrantees and guarantees
- Record plans or as-built drawings

An interim step is "beneficial occupancy" where the Project Sponsor accepts only part of the total contracted facilities, systems, or equipment. This often occurs prior to project completion to give the Project Sponsor the opportunity to do force account work and to initiate pre-revenue service. It is important to clearly define who has responsibility for O&M, safety, and security at this stage. "Substantial completion" refers to the entire contracted work product being accepted for use. This term is also used when the Project Sponsor accepts a portion of the work where only minor punch list work remains.

The terms guaranty (guarantee) and warranty are commonly used interchangeably to describe the responsibility of a manufacturer after delivery of a product and to describe the responsibility of a contractor after completion of construction. Though frequently misused in business, the law has assigned slightly different meanings to the terms. Legally, a guaranty is a separate contract by a third party (analogous to a surety bond), that assumes responsibility in case the principal fails to perform. A warranty is assurance by the principal that it will assume stipulated responsibilities for completed portions of the project. Thus, a manufacturer warrants its material, while the construction contractor provides a third-party guaranty for those materials and a warranty for its own workmanship in installing them.

5.3 Contractor Requirements

Project implementation may, as discussed elsewhere, utilize one or many different contract delivery approaches. In each delivery approach, these contracts impose many responsibilities on both the Project Sponsor (and its consultant extensions of staff) and the contractors selected to perform the work defined by the plans and specifications. The Project Sponsor's organization must assure that those responsibility provisions are consistent with the delivery method, which allocated roles and responsibilities between the Project Sponsor's organization and outside consultants and contractors. Care must be exercised by the Project Sponsor in fulfilling the roles and responsibilities based on the implementation approach, recognizing the inherent differences between traditional, D/B/B, and alternative project delivery methods such as D/B or D/B/O/M.

5.3.1 Permits

During the design phases, the Project Sponsor is responsible for obtaining master and detailed agreements with all relevant governmental jurisdictions, agencies, and utilities. If these agreements are not in place by the bid date (or assured by a later date that would otherwise cause a delay), it may be more appropriate to delay the bid or NTP rather than incur a contractor delay claim because the contractor has no place to work. The contractor should be responsible for obtaining all permits related to the actual construction for which it is responsible. The cost and schedule impacts of this contract requirement should be the full responsibility of the contractor.

5.3.2 Safety Plan

The contractor should develop a safety plan for the contractor's project responsibilities in accordance with the specification requirements (possibly including the Project Sponsor's or project's System Safety Program Plan and/or its Construction Safety and Security Manual) for the Project Sponsor's review and approval. This may include appropriate revisions of the draft version, if required, to meet the Project Sponsor's requirements. An important aspect of the contractor's safety organization is its independence from the contractor's organization responsible for accomplishing the actual work.

5.3.3 Security Plan

Just as with safety, the contractor should be expected to develop a project security plan that complies with the specifications set by the Project Sponsor. For large projects with many contractors, to assure that safety and security plans are both consistent and complete throughout the project, Project Sponsors would be wise to develop a Construction Safety and Security Manual that is distributed along with bid documents.

Construction sites that for any reason are deemed more vulnerable to security breaches should have specifications in the bid documents to cover these contingencies. For instance, a work site adjacent to an active portion of the rail system may require greater traffic control or property protection than one isolated from other portions of the transit system. Similarly, a location adjacent to a tunnel, a major sporting venue, or a historic site may be deemed to have a higher vulnerability for attack, for which the Project Sponsor should consider specifying a higher level of security, including, possibly, surveillance cameras, additional lighting, or constant or roving patrols by contract guards.

5.3.4 Quality Plan

The Project Sponsor should require the contractor to develop a quality plan for the contractor's project responsibilities in accordance with the specification requirements (possibly including the Project Sponsor's or project's quality program) for the Project Sponsor's review and approval. Appropriate revisions of the draft version should be made, if required, to meet the Project Sponsor's requirements. An important aspect of the contractor's quality organization is its independence from the organization responsible for accomplishing the actual work.

5.3.5 Submittals of Shop Drawings or Contract Data Requirements

The contractor should submit a Contract Data Requirements List (CDRL) that itemizes the shop drawings, manufacturers' standard schematic drawings, manufacturers' calculations and standard data, product literature installation instructions, O&M manuals, training documentation, and any other documents or samples as required by the contract specifications to the Project Sponsor's representative for review. Final shop drawings and all manufacturers' product information should become permanent project records, and final payment should not be made until all such material has been submitted and approved by the Project Sponsor.

5.3.6 Submission of Requests for Information

An RFI is a formal means for a contractor to obtain an interpretation of the Project Sponsor's design documentation or other contractual requirement that is not apparent to the contractor. Omissions, conflicts, or other inconsistencies in the drawings or specifications should be rectified by issuing a change notice to the contractor. Clarifications that do not require a change in the contract specifications should be made by a written response to the RFI.

5.3.7 Schedule

See Section 3.4.4 for guidance relating to the construction schedule.

5.3.8 Progress Reporting and Invoices

The contractor should submit periodic progress reports and invoices in accordance with the specification requirements. To encourage early compliance with each and every specification dealing with technical or administrative submittals, the Project Sponsor should promptly reject all contractor submittals until and unless they adhere to the contract requirements. However, preparation of the invoice may be and usually is a joint effort involving both the contractor and the RE's office, and this process eliminates most last minute rejections.

As discussed earlier in this chapter, the contractor should submit Progress Reports monthly; these reports should generally include the following:

- Milestone summary schedule and cash flow payment curve
- Current contractor's schedule for submittals or CDRL update
- Affirmation of latest Project Sponsor approved construction (or other contract) schedule, or notice of change(s) contractor intends to propose for Project Sponsor approval
- Fiscal summary for contract and major subcontracts (award amount, executed change orders, current commitment, payment dates, percentage expended, actual expenditures versus baseline cash flow, pending change orders, and potential claims)
- Certified payrolls
- Change orders, including description, status, and outstanding issues
- Claims status, including description, status, and outstanding issues
- A one-month look ahead narrative
- Systems design status by major milestone
- Facilities construction status by major milestone
- Procurement status
- Systems procurement/installation status by major milestone
- Integrated testing status by major milestone
- Submittals/deliverables status per the contract terms, and, at least, by major milestone
- Quality assurance/quality control status including test schedule/status, non-conformance status and actions taken, and audits scheduled/completed and significant findings
- Environmental mitigation status including compliance/non-compliance reports, completed mitigation efforts, public complaints, non-compliance issues raised by regulatory/oversight agencies, and hazardous material status
- Construction safety status, including reportable accidents, training, and other relevant safety information such as labor hours worked and current incident rate
- Construction security status, including any breaches, particularly those resulting in injury to employees, significant losses due to theft, or crimes against the site or surrounding area
- Disadvantaged, minority, local, women-owned, small business enterprise participation reports as required by contract
- Photos showing recent progress
- Disadvantaged business enterprise status by subcontractor including last payment time and amount, amount paid to date, original subcontract value, and change orders

- Permit application report including the status, including expiration dates of those obtained by the Project Sponsor and those obtained by the contractor, and permit modifications
- Coordination with other contracts, including meetings and written communications
- Utility work status by major utility
- Extra work
- Status of other activities including significant events, public affairs, and insurance

5.3.9 Record Drawings and Documentation

The contractor should submit all record drawings and documentation in accordance with the contract requirements.

5.3.10 Operation and Maintenance Manuals and Training

The contractor should prepare and submit all O&M manuals and training program documentation and should conduct the actual training programs for the Project Sponsor's (or operator's) staff in accordance with the contract requirements. The specifications should address the systems and subsystems for which manuals and training are required, the media for these materials, quantity and schedule, formatting standards, and other detailed requirements.

When the capital project is associated with the extension of an existing fixed guideway system, the new O&M manuals and training must be consistent with existing documentation. The operating managers should be closely involved in any proposed revisions to these manuals.

5.3.11 Testing and Inspection

The contractor should conduct testing and inspection in accordance with the contract requirements. FTA has identified an inspection and testing system in its Quality Assurance and Quality Control Guidelines (FTA-IT-90-5001-02.1, 2002) [Ref. 2-57]. The specifications should address the systems and subsystems for which testing is required, the functionality requirements, factory testing, field testing, integration testing, documentation, test planning, scheduling, procedures, reporting, and staff support requirements.

Inspection requirements should be directly related to the contractor's QA/QC responsibilities as documented in its Quality Plan, as discussed earlier in this chapter.

5.3.12 Closeout Activities

Project closeout activities are required (see Circular 5010.1D, Grant Management Requirements [Ref. 2-29]) by FTA to determine that all responsibilities and work required of the Project Sponsor have been accomplished. These include the following milestones and activities:

- O&M training is conducted by the contractor and/or the Project Sponsor, as required.
- Substantial completion when the Project Sponsor can take beneficial occupancy of the facility. A Certificate of Beneficial Occupancy is issued by the Project Sponsor including a punch list of open items for the contractor to complete.
- Record plans or "as-builts" are prepared by the contractor.
- Guaranty and warranty provisions are initiated by the contractor.
- Final Inspection is performed by the Project Sponsor, but only after the RE conducts a pre-final inspection and agrees that the work is ready for the Project Sponsor to participate in a final inspection.
- Turnover of keys to facilities from contractor to Project Sponsor.
- Submission of signed contractor affidavits in regards to payment of debts and claims, and release of liens by the contractor to the Project Sponsor.
- Final payment is made by the Project Sponsor to the contractor.
- A final report is prepared by the contractor and the Project Sponsor that includes the final cost, as-built schedule, and lessons learned.
- Final cost report by the Project Sponsor.

5.4 Construction Safety

Both FTA and Project Sponsors have a stake in the establishment of policies and 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 of the size and complexity usually encountered.

Note that FTA Circular 5800.1, Safety and Security Management Guidance for Major Capital Projects (MCP) [Ref. 2-49], is a requirement for all MCP and/or NS Project Sponsors, as well as a guide relative to such principles for other transit capital projects. This section is written to apply the principles of the circular across all transit projects. MCP and NS Project Sponsors *must* adhere to the circular's documentation and processing requirements.

The prevention of accidents during execution of a major transit capital project should be a primary concern of all participants; the responsibility for a safe workplace rests with all levels of management and supervision. Accidents cause suffering to those involved and result in project delay and additional expense to Project Sponsors and contractors. A low accident rate is a direct result of a carefully planned and implemented safety program that is conscientiously developed and carried out by the Project Sponsor's insurance carrier, management, and supervisors. Overall responsibility for assuring the development and implementation of a safety program rests with the Project Sponsor's project management; the following discussion is offered as general guidance.

5.4.1 Safety Program Management

The safety program for managing any transit construction project should be formulated on the following basic presumptions:

- 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 should never be sacrificed for production and should be considered an integral part of risk management, quality control, cost reduction, and job efficiency.
- A good safety record reflects the quality of management, supervision, and the work force.
- The established policy should be to accomplish the work in the safest possible manner consistent with good work practices. Management at every level should be charged with the task of translating this policy into positive actions.
- Contractors with a good safety record on prior projects tend to maintain a good record and run a safe and efficient job on new work. Consequently, a contractor's safety performance record on prior work could be a factor if pre-qualification of bidders is employed by the Project Sponsor.
- Members of the workforce obtain proper safety training before they start assignments on the project. Very often accidents involve or can be attributable to new hires.

The following general provisions should apply:

- The safety program should outline management safety policies and procedures and be in compliance with and be supplemented by all applicable Federal, state, and local safety and health regulations and standards.
- Specific contract and Project Sponsor requirements should be stated.
- In case of a conflict between standards or regulations, the stricter requirement should apply.

The Project Sponsor's project manager should have full responsibility for executing and implementing a program of employee protection and accident prevention on the project. A responsible safety manager should be designated to administer and supervise the overall project safety program.

- *Safety manager* – The Project Sponsor's designated safety manager should have the authority and ability to enforce established safety requirements. While some Project Sponsor organizations may have the safety manager report directly to the project manager it is common practice to have the safety manager report independently to a level above and outside of the project manager, to provide a check in case of conflicting pressures to advance the project while compromising on safety. While the contractors are primarily responsible for safety, the Project Sponsor's safety manager is responsible for providing overall safety surveillance and guidance to the contractors and for monitoring contractors' safety programs and safety performance.

- *Project contractors* – Each contractor should have full responsibility for executing and implementing a program of employee protection and accident prevention that is consistent with the requirements of the overall project safety program. Therefore, contractors may also have a safety manager in addition to the overall safety manager provided by the Project Sponsor.

The safety manager or other competent safety personnel and project supervisors should conduct daily inspections of work operations, equipment, storage areas, and facilities. Unsafe acts or unhealthy conditions should be noted and pointed out to the supervisor in charge. Serious or repetitive violations should be documented and transmitted to the contractor's representative for corrective action.

When a condition or practice exists that could reasonably be expected to cause serious physical harm, extensive damage to property or death, it should be the policy of the project manager to cease operation on the portion of the work affected until the hazardous conditions are corrected. Carelessness or disregard for accepted and mandatory safety and health standards should not be tolerated. Contractors should be expected to discipline or terminate employees who violate established rules and regulations. The Project Sponsor typically reserves the right under the construction contract to remove any individuals from the project if they are deemed a safety risk to themselves or others.

5.4.2 Pre-Construction Survey to Identify Potential Hazards

As an element of a sound system safety program, the Project Sponsor and experts in construction risk management should conduct a pre-construction survey of both the project ROW and adjacent areas, to identify potential hazards that are unique to the specific project under consideration. The physical existing structures and facilities included in that survey will be identified for monitoring their structural integrity during construction. The approximate frequency and severity of the hazards can provide guidance to the Project Sponsor for their resolution or mitigation. The information from these surveys should be used by the Project Sponsor in evaluating risk responsibility and response and developing or amending appropriate contract documentation (drawings, specifications, special conditions) as those surveys may require.

5.4.3 Construction Hazard Control

The following safety tools are used during all phases of construction:

- *Certification* – Approval for projects could be contingent on the Project Sponsor and other responsible parties providing written documentation, in adherence to its PMP, defining the scope and application of a safety management program.

- *Responsibilities* – In general, the RE for the contract is the individual most closely related to the activities of contractors and other participating organizations and is therefore responsible for ensuring compliance with all aspects of the contract including applicable safety orders.

- *Documentation* – Project Sponsors should be responsible for preparing a Safety Management Plan. It is normal practice for contracts to include safety specifications and procedures patterned after Federal and state occupational safety and health standards. Employers are required by law to provide a safe place of employment. In recognition of the dual role that many safety documents play by also including security requirements, all such plans should have the words "safety" and "security" in their titles, such as a Safety and Security Management Plan (SSMP), or a Safety and Security Construction Manual.

- *Procedures and Controls* – Contract specifications should describe procedures to be followed in effecting the control and monitoring of a project safety program. As a minimum, the following considerations are recommended:
  - Mandatory safety orientations for each new contractor/subcontractor field employee
  - Hazards analysis
  - Weekly safety meetings
  - Site access control procedures
  - Mandatory contractor safety program
  - Preconstruction safety reviews
  - Inspection of unsafe working conditions
  - Inspection of tools
  - Daily housekeeping
  - Encouraging safety awareness reinforcement awards for safe practices
  - First aid and medical facilities
  - Fire prevention and protection
  - Emergency response procedures and routes posted on site
  - Enforcement of subcontractor programs
  - Sanitation
  - Public protection
  - Protective clothing/equipment
  - Tool box/lunch box meetings
  - Construction equipment operation regular scheduled checklist inspections
  - Employee skill certification

- *Accidents and Emergencies* – Procedures should be identified for quick response to accidents and emergencies to ensure the safety of personnel and property, and employees should be aware of these procedures. The RE, control groups, and contractors must move rapidly following an accident or unsafe incident to isolate the cause and prevent recurrence. In a similar manner, the RE and the contractor should agree on procedures to be followed in the event of an emergency, to include persons to be notified, operational procedures, coordination with public agencies, protection of project and private property, and protection of persons against further harm. Appropriate lists of emergency telephone numbers should be maintained and employees should be aware of where they are posted.

5.4.4 Employee Orientation and Training

The Project Sponsor’s safety department or the project’s risk manager or insurance consultant should implement employee orientation and training to achieve the objectives of safety awareness and accident reduction by managing risks and minimizing hazards. Three specific groups of employees need to be addressed: the constructors (probably, but not necessarily, a private contractor), the construction management and support personnel working and all visitors to the job site (no matter their employer), and the transit O&M personnel. When the capital project involves a modification to, or expansion of, an existing transit system or facility, the transit O&M employees should be exposed to the project from the outset. For completely new capital projects, the O&M employees will become involved towards the completion of the project as it approaches integration testing and start-up.

Safety orientation and training should focus on initial awareness and procedure compliance, with periodic updates throughout the project implementation. A continuous process of hazard identification and resolutions should be established as well as a lessons learned/best practices program. Contractors not familiar with fixed guideway transit facilities and their inherent hazards should receive intensive training, and certification, prior to having access to certain parts of the transit system, such as the trackway.

5.4.5 Safety Inspections and Audits

A systematic construction safety program should include periodic safety inspections and audits by a group that is independent of those doing the construction. Inspection and audit findings should be documented and corrective actions promptly implemented to maintain a high degree of jobsite safety.

5.4.6 Accident Reporting and Investigations

Accident reporting and investigations should be accomplished in accordance with Occupational Safety and Health Administration (OSHA), state, and local requirements and the project’s construction safety program procedures. Accidents should be documented and analyzed, and corrective actions implemented to address inherent hazards.

5.4.7 Use of Contract Incentives

Several Project Sponsors and capital projects have used safety incentives in contracts whereby the contractor can benefit financially by having a good construction safety record. Usually, these incentives direct correspond to the savings in insurance premium that result from a good accident performance rate. The potential for monetary reward provides the incentive for contractors to have a proactive and effective safety program. Even in projects with “wrap up” insurance, i.e., an Owner Controlled Insurance Plan (OCIP) provided by the Project Sponsor, the record for each contractor’s project performance can be discerned and documented so that it can serve as a strong incentive to them.

5.5 Construction Security

The Construction phase has historically not paid as much attention to security as to safety. In recent years, Project Sponsors have been required to take a more active role in determining both the safety and security requirements that contractors must adhere to, but, because security had previously received little attention, the change has been more noticeable in this area. The changing requirements also reflect the importance the SSMP places on establishing more defined safety and security roles of Project Sponsors during the Construction phase of a project.

A number of documents specific to construction should be developed early in the project to assure that project managers are aware of site-specific issues. In addition to the recommended Construction Safety and Security Manual (CSSM), during construction a project should require that each contractor submit a Contractor Safety and Security Plan (CSSP) that explains how the contractor will meet or exceed the safety/security requirements issued as part of the bidding process.

Security breaches can have a major impact on a construction project. The security of the contractor's employees, those in the area surrounding the construction site, and the site itself may cause delays to a project, add expenses, and create the impression in the minds of area residents that the transit system is supporting an eyesore or unsafe location. A construction site that is secure – where crimes do not occur or that does not add visible blight to the neighborhood – will minimize danger and will help to maintain good public relations for the Project Sponsor's agency. Overall responsibility for assuring that the contractor develops and implements a security program rests with the Project Sponsor's project management, so the Project Sponsor must assure that it retains the authority to have input into security arrangements.

5.5.1 Security Program Management

Similar to the safety program, the security program for a construction project should be formulated on the following basic assumptions:

- Management and supervision are charged with the responsibility of preventing the occurrence of security breaches that could lead to injuries at the site or to losses of equipment or materials.
- Security should be considered an integral part of risk management, quality control, cost reduction, and job efficiency. Workers fearful of becoming crime victims will work with neither high morale nor peak efficiency.
- Maintaining a crime-free construction site reflects the quality of management, supervision, and the work force, and can aid the Project Sponsor in maintaining good relationships with the community.

To assure that these provisions are met, the Project Sponsor must assure that someone in its project organization has responsibility for overseeing the contractors' security program. In large Project Sponsor organizations, where there is an active police or security department, the manager of this department should play an active role in this function. In smaller organizations, this role may pass to the safety manager. In such cases, though, the safety manager must know that this is part of his/her responsibilities to assure that the contractors' security program(s) will receive proper oversight.

The contractor may have a division of labor similar to the Project Sponsor. For very large projects that are located in high-traffic or high-vulnerability areas, the contractor may be required by the Project Sponsor to employ a specific security manager in addition to its safety manager. On smaller contracts, the safety manager likely will take on security responsibilities as well. In such instances, the Project Sponsor must assure that its own and the contractors' safety managers are aware of these responsibilities and have the training and knowledge to make security decisions or must assure that relevant consultants or subcontractors are employed who are able to perform these functions.

Site security personnel and those on the Project Sponsor staff who will provide guidance and have responsibility for assuring that a security program is in place should be aware of the findings of the Threat and Vulnerability Analysis (TVA) to assist in assessing vulnerabilities and should have familiarity with principles of Crime Prevention Through Environmental Design (CPTED), Situational Crime Prevention (SCP), and the basic principles of the use of barriers, CCTV, and access/exit control to maintain site security.

The security manager or individual designated with security responsibility should conduct periodic inspections of working areas, equipment, storage areas, and facilities and should assure that property inventory-control mechanisms exist and that all deliveries, visitors, etc., are properly logged in and out. The Project Sponsor's police/security manager should be assured unlimited access to the work site to assess whether security plans are being adhered to and should have the authority to order corrective action if the plans are not being followed.

5.5.2 Construction Safety and Security Manual

The most effective way to assure that its security (as well as safety) requirements are defined for contractors is for the Project Sponsor to develop a CSSM. This document should outline the Project Sponsor's security policies and procedures and should be included in all bidding documents to assure that contractors are aware of the potential costs of maintaining a certain level of protection and factor these into their bids. The CSSM should indicate the level of safety and security the Project Sponsor requires to be maintained at sites. It should describe the procedures and controls for assuring these requirements are met and monitored by Project Sponsor personnel or designated safety and security consultants who, in turn, report to Project Sponsor personnel.

The information contained in the section above on safety details what should be discussed in the safety procedures and controls. In addition to these, security-specific sections of the CSSM should discuss and contain policies for:

- Site access control procedures for employees and, visitors (including inspectors), including log in/log out procedures and how records of access will be maintained
- Procedures for controlling delivery vehicles, including log in/log out procedures, who is designated to physically check waybills and delivery vehicles entering and exiting, and how the records of access will be maintained
- Inspection of improperly secured work areas, and making decisions on the need for/use of physical barriers and/or uniformed security personnel to maintain access and/or inventory security
- Security awareness training, including crime reporting policies (whether to the Project Sponsor or local police) and location of emergency telephone numbers and emergency first aid supplies
- Vehicular and pedestrian traffic control in and around the construction site and immediate area.

5.5.3 Construction Breach Control

Details for the site protection of specific areas of construction should be based on a TVA that has previously identified threats unique to any portion of the project, including its location and any controversies surrounding it.

5.5.4 Employee Orientation and Training

All employees, but especially those assigned to a location determined to have a high vulnerability index, should be made aware of security policies through orientation and training, and also of the negative consequences of violating these policies. They should be particularly aware of access/egress policies, sign-in policies, requirements to park in designated areas, and the need to report any security breaches to supervisory staff. They should also be made aware that illegal activity on their part, particularly involving drugs or thefts, will result in arrest and prosecution.

5.5.5 Breach and Crime Reporting and Investigations

All employees assigned to a construction site must be aware of the breach and crime reporting policies established and must be aware that either the Project Sponsor's police or local police retain the authority to investigate breaches and crimes that occur on the site. A clearly worded police report form should be established to indicate how soon after a breach or crime has been detected that it must be reported to supervisors, to whom and in what time period supervisors must report the incident to the Project Sponsor and local police, and what policies have been established if an actual crime scene must be delineated.

5.6 Insurance

The concept of insurance protection should be considered carefully and established early in the project's planning and development stage. This area of management requires expert knowledge, and unless a staff of such a caliber is already employed, outside consultants should be hired to design and implement a program and be employed until staff is hired and experienced enough to assume such responsibilities. Although cost-effectiveness should be the paramount goal of any program, the means of achieving this goal require careful analysis.

The Project Sponsor has two primary alternatives for insurance protection -- conventional and coordinated, or wrap-up. While the latter approach has gained popularity for larger projects, it has been criticized for not providing strong incentives for contractor safety performance. The Safety Awareness Program associated with numerous projects around the country can be investigated and adopted/adapted to overcome this limitation by sharing reduced Project Sponsor insurance cost with contractors, based on their safety performance. Thus, contractors have a monetary incentive to maintain an effective safety program.

5.6.1 Conventional or Contractor-Controlled Insurance Program

The Project Sponsor will have its own insurance program that determines the requirements listed in the contract documents that define the insurance coverage limits for the contractor. With the conventional insurance approach, each contractor and subcontractor arranges a separate program of insurance and submits their certificates providing proof of coverage. Such an approach may not be cost-effective for any of the following reasons:

- Lack of economy in volume purchase
- Lack of financial security (stability) of marginal contractors
- Specifications that are the minimum necessary to protect the Project Sponsor
- The difficulty of administering many individual policies with varying limits of liability subject to different terms and expiration dates
- Redundant charges by contractors (e.g., general and administrative overhead and profit)
- Project delay from cross litigation by various insurance companies over claim payments
- Contractor delay or failure to collect claims from substandard insurance companies (the Project Sponsor may be required to make dollar advances to keep contractors solvent)

5.6.2 Coordinated (Owner Controlled or Wrap-Up) Insurance Program

An alternative to conventional insurance is an owner-(Project Sponsor)-designed and owner-controlled program known as a coordinated insurance program (OCIP, as described previously and discussed below) or "wrap-up" insurance.

The advantages of an owner-controlled program are that:

- The owner, not the contractor, negotiates policy terms and costs, eliminating redundant charges for expense and profit items.
- The administrative burden of maintaining records on contractor compliance with contract specifications for insurance is eliminated. (All contractors have the same coverage limits with set expiration dates of polices dependent on the contract's duration.)
- The safety and loss control programs are uniform.
- Cross litigation is eliminated.
- Claim handling is uniform.
- Small and minority contractor participation in the project is not excluded because insurance is available.
- Insurance costs are confined solely to the project through self-rating.
- Cash flow advantages become available to the owner.

Its disadvantages are:

- Insurance costs are highlighted in one large package.
- The owner's staff may not be adequately trained or available to handle a program.
- The contractor should be fully responsible for all costs related to its performance.
- The contractor may be better able to manage its own insurance and safety programs. (It takes the consequences if it is wrong and relieves the owner of this burden.)
- Management of the risk management program is costly.
- Insurance costs are not subject to as many competitive forces.

The types of insurance usually placed in an OCIP are workers' compensation; comprehensive general liability, including products and completed operations; railroad protective liability; and builder's risk. This coverage applies to the owner and all contractors involved in the project, with the exception of hauling contractors (unless activities are exclusive to the project) and supply contractors. Contractors dealing with hazardous materials and/or waste are often excluded from an OCIP. Surety bonds are the responsibility of each contractor. However, when an owner-controlled program exists, it is possible to develop a small- and minority-contractor surety bond program with insurance companies to enhance the probability of participation by these contractors.

This type of program can also be implemented by a Contractor Controlled Insurance Program (CCIP) that is a wrap-up policy carried by the contractor. Such policies can use the contractor's market purchasing power if the project attracts large and sophisticated construction organizations to provide cost savings and administrative efficiencies.

For a comparison on types of insurance, see:

- ☞ Section 6-6 of the *FTA Best Practices Procurement Manual* [Ref. 2-22]
- ☞ *Wrap-Ups: How to Consolidate Construction Insurance and Gain Control, Cost Savings and Improved Community Relations* [Ref. 5-3]

5.6.3 Partner-Controlled Insurance

As an alternative approach to owner-controlled insurance, partner controlled insurance is designed to provide project-related insurance to all project participants. The insurance, however, is controlled by a consortium representing both the Project Sponsor and the contractors, with appropriate incentive for safe construction by all project participants.

CHAPTER 6 – MANAGING THE PROJECT DURING THE TESTING AND START-UP PHASES

6.1 Introduction

The Testing and Start-up Phase provides the link between the Procurement/ Construction and Revenue Service phases for fixed guideway projects, though principles may be applicable to bus facilities and specialized equipment purchases. The purpose of this phase is to determine acceptability of the newly constructed or modernized transit system in preparation for revenue operations. Where applicable, this is often referred to as the Rail Activation Phase. Acceptance follows verification that the project meets the contractual specifications by conducting system, performance, and acceptance tests. After construction has been safety certified and completed, the Testing and Start-Up Phase begins with qualification, acceptance, and performance testing as well as integrated testing. In addition to safety certification of the testing program, a period of pre-revenue service is required to familiarize the Project Sponsor (or contractor) management and operations and maintenance (O&M) personnel with the new system prior to beginning, resuming, or extending revenue service. Final SSC issues, procedures development, training, emergency preparedness, and customer interface are addressed during this phase. Discussion is oriented to the requirements of a fixed guideway system that serves the public. Other transit capital projects should also follow this guidance, recognizing that their “customers” may be the transit agency’s own employees, e.g., a maintenance facility construction or rehabilitation.

Although testing and start-up is the bridge between construction and revenue service, planning for each must begin during design. Implementation contracts should specify the requirements for system, performance, and integration testing, as-built drawings, O&M manuals, training, rules and procedures (if not agency developed), acceptance, and warranty requirements. The contractor’s responsibilities and participation requirements during testing and start-up need to be clearly described in the contract. This phase may overlap with the Procurement/Construction phase in projects that are designed to open in segments, or D/B projects since component, subsystem, and installation verification tests are performed while construction continues on other segments.

This chapter supplements management principles presented in Chapter 3 with project management guidelines specifically related to the Testing and Start-Up Phase of a transit construction project.

For Major Capital Projects (MCP), a formal Rail Activation Plan (RAP) is the best course for Project Sponsors to follow. This plan should identify the management organization and responsibilities for testing and start-up. Typically, a Rail Activation Committee (RAC), chaired by a Rail Activation Manager (RAM), or similarly named committee and chair. The RAC should consist of the Project Sponsor technical, construction, and operational personnel, as well as stakeholder, responder, consultant, and contractor personnel. Section 6.4 discusses the possible organization of the RAC.

6.2 Test Program Planning

An element of the PMP is test program planning. Planning should:

- Ensure that all contractually required tests are fully specified in the contract documents, including identification of those that must be witnessed by the agency.
- Clearly identify any contractor role in developing the Integration Test Plan (ITP) and test procedures.
- Establish the management of and process for conducting, monitoring, and approving the test program.
- Define the test prerequisites and test objectives.
- Define the system integration test organization and specify its authority and responsibilities.
- Describe the administrative requirements of the test program.

The testing program should be developed to ensure that management and technical resources are applied in a coherent and organized manner to achieve the testing objectives. If there is overlap between the construction and testing phases and if it is intended that contractor personnel, under supervision of agency test managers, are to perform any System Integrated Testing (SIT) activities, the ITP and the contract specifications should both include language to define the contractor's support role in SIT.

The test program should include the following elements:

- *Identification and definition of contractual test requirements* – Contract specifications should define those tests necessary to ensure that equipment and constructed elements meet design and performance requirements. These contractual tests done during the Construction Phase must be completed prior to SSC of construction or system acceptance. These are prerequisite to SITs done during the Testing and Start-Up Phase.

- *Identification of system integration tests* – SITs must be performed after contractually required tests are completed on all elements that must be successfully integrated for safe and secure operation. The ITP should identify all planned system integration tests to be performed to ensure that necessary compatibility has been achieved among all elements of the new system and with the existing system.

- *Establishment of a test program administration system* – The ITP should identify the organization that will identify the required SITs, establish pre-requisite requirements, develop the test procedures, schedule and conduct the SITs, complete the test reports, establish documentation requirements, and maintain the test documentation. Administration of the test program on larger projects will be a major undertaking and would best be managed through computerization, using a system to monitor, control, document, and report on program status. A test numbering system should be established to assist in the administration and retrieval of testing documents.

- *Development of testing sequence and schedules* – A test schedule should be included in the ITP and coordinated with the overall project schedule. The initial test schedule, developed when planning SIT during design, should be updated regularly during the Construction/Procurement and Testing and Start-Up phases of the project. A SIT Committee (SITC), or similar test management team, should be initially identified in the project's Safety and Security Management Plan (SSMP), and then detailed in the ITP. In many projects, the SITC is one of the subcommittees of the RAC, or similar overarching organization that starts functioning during the mid-construction phase and has fully responsibility for coordinating SIT, PRO and other start-up requirements, and the completion of SSC of the project. The SITC, or similar group, should manage the test program. A designated Project Sponsor manager should chair the SITC. Each SIT should be performed by a test engineer (either the SITC chair or reporting to the chair), assisted as appropriate by contractor, consultants and Project Sponsor staff.

6.3 Test Program Elements

6.3.1 Contractually Required Testing

Contractually required testing should begin during the Construction/Procurement Phase and continue through the end of construction. On projects that are completed in segments, the Testing and Start-Up Phase may be active in a segment that has completed construction and all contractually required tests, while construction and contractually required testing is ongoing in other segments. All contractually required testing must be completed in a segment before that segment can enter the Testing and Start-Up Phase. Contractually required tests are in the following categories:

- *Qualification Tests* – The contractor at the component and subsystem levels should conduct in the factory design qualification tests and analysis during contractor engineering to demonstrate compliance to the specifications.

- *Production Verification Tests* – The contractor at the component and subsystem levels conducts production verification during production in the shop to ensure that the product performs in accordance with design.

- *Construction Inspection Tests* – The contractor at the component and subsystem levels conducts construction inspection tests in the field to ensure that the product was installed and performs in accordance with design.

- *Installation and Verification Tests* – The contractor at the subsystem level conducts installation and verification tests to ensure proper installation.

- *Acceptance Tests* – The Project Sponsor or its representative conducts acceptance tests at the system level to verify that all delivered and installed equipment performs as specified.

- *Demonstration Tests (Post Construction)* – The Project Sponsor, its representative, or contractor conducts tests to demonstrate the performance and reliability of the system equipment in the Testing and Start-up and Revenue Service phases. An Incident Evaluation Committee, or similar identified group, chaired by the test engineer, evaluates the relevance of all failures during the demonstration test program (which may extend many months into operations) and identifies corrective action to be taken where and when necessary.

Contractors should be required by contract to prepare plans and procedures for tests they are contractually responsible for performing. The contractor should be required to submit the test plans and procedures for review and approval. A Project Sponsor representative (agency staff or supervised consultant) should perform a thorough review of the test plans and indicate whether they are acceptable before authorizing the contractor to proceed with testing. The contractor should be required to prepare test results and reports for review by Project Sponsor representatives. The representative's review should result in providing the contractor with written approval or rejection of the tested component or subsystem.

Project Sponsor representatives should develop plans, procedures, and reports for acceptance and demonstration tests. Tests should be scheduled, conducted, and documented in accordance with the approved schedules, plans, and procedures and should be monitored by Project Sponsor representatives. Formal reports on the status of the test program should be issued at least monthly to project management.

Requirements for testing of materials should be defined in the construction contract for both construction materials and materials used in the fabrication of equipment. In addition, testing of products for which fabricators submit material certificates or certificates of compliance should be conducted on a random basis or when the validity of the materials or products, or documentation is questionable. Contract-specific inspection and test plans should identify the products or materials that require testing.

6.3.2 System Integration Testing

Upon completion of contractually required acceptance tests, SIT should be performed to demonstrate the ability of various subsystems and facilities to work as a system and for the new or modernized system to function with an existing system. An Integration Test Plan (ITP) is often developed to describe the SIT process. Each integration test should be documented in a formal report prepared by the Project Sponsor representatives who conducted the test. The ITP should encompass:

- Organizational roles and responsibilities
- Testing objectives
- Test approval process
- All planned tests and schedule
- Test procedures
- Test reports
- Documentation requirements

Project Sponsor staff should perform the SIT, with support as needed from consultants. A SITC or similar test management team should be identified in the project's SSMP and detailed in the ITP. In many projects, the SITC is one of the subcommittees of an overall Rail Activation Committee (RAC), or similar overarching organization that begins functioning during the mid-construction phase and has fully responsibility for coordinating the test program including the SIT, pre-revenue operations (PRO) and other start-up requirements, and the completion of SSC for the project. A Project Sponsor manager should chair the SITC.

The SSC Committee (SSCC) should review and sign acceptance of all SIT procedures for elements that affect system safety or security to ensure that successful completion of the SIT will assure that identified hazards and vulnerabilities have been controlled or eliminated. Each SIT should be performed by a test engineer (either the SITC Chair or reporting to the Chair), assisted as appropriate by contractor, consultants and sponsor staff.

Contract and Procurement documents should contain language to require equipment suppliers to participate in tests of their equipment so that problems can be expeditiously identified and corrected. Equipment changes resulting from systems testing should be subjected to the configuration management procedures defined for the project.

6.3.3 Operational Tests

Many SITs are required to interface train operation with constructed and installed systems. These SITs are performed after the individual constructed elements and systems are tested to ensure that the systems will support train traffic safely and securely at reduced speed under test conditions. Sample operational tests include:

- *Clearance* – Verification that trains adequately clear fixed objects, and other trains, at all operational speeds

- *Train braking* – Verification of car/train stopping distance in every possible situation

- *Signals* – Verification that signals operate as expected in every possible situation and that sight distance for operators is adequate

- *Power (substation)* – Verification that substations supply the voltage and current as expected in every situation including when maximum train consists accelerate simultaneously from identified locations; verify that trains operate satisfactorily when receiving the minimum specified voltage

- *Power (car)* – Verification that a car/train still operates properly when the voltage falls to its minimum

- *Speed* – Verification that train ride quality is acceptable at all speeds up to the maximum allowable; verification that there is good OCS or third-rail contact with train pick-up at all speeds; verification that trains operate satisfactorily through track switches at maximum allowed speeds, over all moves

- *Wheelchair devices* – Verification that devices interface with the cars properly

- *Fare collection systems* – Verification that devices collect and record fares properly; that their placement is conducive to safety and security for patrons and for staff or others who must service the equipment

- *Entry/exit systems* – Verification that elevators and escalators meet code requirements, that stair banisters, pitch, etc., meet code requirements, and that safety and weather-related equipment been properly installed. If the system is not barrier-free, verify that turnstiles and similar equipment operate properly and are tested for exiting capabilities in the event of a location emergency

- *Emergency equipment and systems* – Verification that specified emergency equipment and systems for ventilation and exhaust, electricity generation, water removal, fire detection and suppression, intrusion detection, detection of WMDs, communications, and lighting are installed and properly operating.

6.4 Management of Rail Activation

Management of Rail Activation should be established in the late design or early construction phase and modified, as required, based on experience as the project progresses. The Project Sponsor should create a RAC, or similarly named group composed of Project Sponsor technical, construction, and operational personnel, as well as stakeholder, responder, consultant, and contractor personnel, as appropriate, based on their anticipated role in rail activation. Individuals who should be considered for membership or as invited guests might include the following:

- RAC Manager (chair)
- SSC Manager
- SIT Manager
- PRO Manager
- Operations Director
- Transportation Manager
- Maintenance Manager
- Control Center Manager
- Training Manager
- System Safety Director (includes Fire and Life Safety Committee)
- System Security Director (or police or security chief, or in small systems, may be the System Safety Director)
- Project Manager
- Public Relations Manager
- Design Manager
- Construction Manager

- Fire Department Representative (Invited Guest)
- Police Department Representative (Invited Guest)
- EMS Representative (Invited Guest)
- State Safety Oversight Agency (SSOA) Representative (Invited Guest)
- Federal Transit Administration (FTA) PMOC Representative (Invited Guest)
- Federal Railroad Administration (FRA) Representative (Invited Guest) – if appropriate to project

RAC subcommittees should be formed to reflect project complexity and to meet FTA requirements as necessary.

6.4.1 Agreements

Agreements need to be negotiated with all affected jurisdictions and agencies that have jurisdiction over the operation of the transportation system. These organizations and their requirements should be identified earlier in the project development process to assure that their requirements are accommodated, to the extent possible, in the design and construction phases. Prior to initiating testing and pre-revenue service, additional required agreements could relate to the following:

- Utilities that directly support the improvement
- Operating permits from the local municipality
- Police, fire, emergency medical, and other emergency response liaisons
- Shared owners of ROW, e.g., streets, highways, railroads, utilities
- Local traffic management interfaces (especially with light rail)
- Adjacent major ridership generators, e.g., university, airport, stadium, and other developments (especially with shared stations)

6.4.2 Establishment/Modification of Operating Organization

The Project Sponsor must establish an organization to perform or oversee project management, operations, maintenance, and supporting functions. If housed in the same organization responsible for implementing the project, a transition will be required from the organization used to direct and oversee the project development to a more operations-oriented organization. In larger organizations, separate capital project and O&M functions can continually co-exist.

6.4.3 Procedures, Rulebooks, and Manuals

The Project Sponsor should develop or modify O&M procedures and rulebooks to address all areas affected by the transit capital improvement. These O&M manuals, procedures, and rulebooks should be developed under management of the PRO Committee and be approved by appropriate O&M managers and the RAC, then safety and security certified by the SSCC before turn over to the operating organization at completion of the Testing and Start-Up Phase. All procedures, rulebooks, and manuals should be living documents, revised to incorporate lessons learned from start-up, as well as those earned during continuing operation.

6.4.4 Recruitment of Personnel

The operating agency must assess the labor required to operate and maintain the transit capital improvement project and recruit personnel with the skills required in time to support the testing and start-up phases, as well as revenue service phases. This will be directly related to the operating plan developed in conjunction with the capital improvement implementation. Vehicle maintenance requirements will be a function of fleet utilization and established inspection and maintenance standards. Depending on labor contracts, local economic conditions, and a variety of other factors, the operating agency should carefully plan when recruitment should begin to assure that there is sufficient time to screen and train employees. The hiring schedule may vary for different categories of employees, again depending on availability of personnel and training requirements.

6.4.5 Training

Plans for a comprehensive training program for all O&M personnel should be part of the PRO Plan and should be integrated with the personnel recruitment plan. Training may be supplied by contractors, the agency, or by both. Training should begin in the late Construction Phase and be completed during project start-up. A major aspect of pre-revenue operations is the hands-on training of all O&M personnel.

For a new rail service, rail transportation training should be developed for all operators, supervisors, and dispatchers. Maintenance training should be provided for the following areas:

- Electrical systems
- Signal systems
- Track
- Shop equipment
- Revenue vehicles
- Fare collection systems
- Vertical transportation systems (escalators and elevators)
- Normal and emergency communications systems, including all landline, portable, and emergency telephone or text-based systems used by operators and other employees
- Security systems, including surveillance, recording, intrusion detection, patron emergency telephones, parking control, and similar electronic systems
- Non-revenue vehicles

The proficiency of all employees receiving training should be tested and verified, and all training should be fully documented in each employee's file. In addition, there may be a requirement for local certification for certain categories of employees.

6.4.6 Pre-Revenue Operations

SIT immediately follows "substantial completion" of construction, and is immediately followed by PRO. PRO should be designed to mimic revenue O&M activities, except that passengers will not be carried. It should be noted that while Emergency Drills are performed during SIT, many transit agencies find it valuable to repeat some drills, either fully or in reduced scope, during PRO as additional training for both agency and responder personnel. The following items may be considered in the evaluation of pre-revenue operations:

- Notification procedures, internally and to external emergency agencies such as police, fire, and emergency medical providers
- Control center response
- Transportation supervisory response
- Maintenance response
- Emergency responder response
- Traction power sectionalization
- Loss of signals and/or communications
- Accident investigation procedures
- Single-tracking performance
- Simulated bus substitution
- Train evacuation, in stations and along the ROW
- Station or other facility evacuation
- Assumption of authority
- Command post protocols, internally and with external responders,
- Rescue trains
- Simulated public notification
- "On the line" vehicle troubleshooting
- Simulated emergency training through a combination of tabletop exercises and full-scale drills in the field

6.4.7 Post-Delivery Audit for Rolling Stock

Prior to transfer of title for revenue service rolling stock vehicles, Buy America regulations require the Project Sponsor to conduct a post-delivery audit verifying the manufacturer's compliance. The following certifications are required for each Post-Delivery audit:

- Post-delivery Buy America certification, verifying that final assembly of all vehicles occurred in the United States and the cost of components produced in the United States is more than 60 percent of the cost of all components for each vehicle type
- Post-delivery Purchaser's Requirements certification, verifying that a resident inspector (on behalf of the Project Sponsor) was on-site in the manufacturing facility during the final assembly period and monitored and documented the final assembly process, and that the Project Sponsor (or entity on behalf of the Project Sponsor) performed visual inspections and performance tests demonstrating that the vehicles meet the contract requirements
- Post-delivery Federal Motor Vehicle Safety Standards (FMVSS) certification, (for buses and highway vehicles only)

Requirements for Post-Delivery Audit are stipulated in 49 CFR 663, and additional guidance is provided on FTA's web site.

6.5 Safety Oversight

Safety oversight of transit is provided as follows:

- The FTA requires states to designate an SSOA to oversee the safety of any fixed guideway transit (non-commuter rail) system within the state.
- The FRA has safety jurisdiction over transit operating on the general railway system (commuter rail).
- In certain circumstances, a waiver from FRA safety oversight may have to be negotiated to permit FTA oversight of transit fixed guideway operations that share the right-of-way with the general railway system, e.g., light rail operating with temporal separation from freight service.
- Except for a few Federal requirements for bus vehicles, such as those related to Federal Motor Carrier Safety Standards (FMCSS), OSHA standards, and FTA bus testing and Drug and Alcohol regulations for bus operations, bus safety oversight is limited to a variety of different state requirements. In general, little oversight relates to the safety of bus capital projects. However, Project Sponsors should develop programs similar to those outlined in these ***Guidelines*****.** If the Project Sponsor also operates a fixed guideway, following programs designed for that portion of the transit system will help to provide safety oversight.

With the implementation of MAP-21, 49 U.S.C § 5329 was revised to increase the SSOA's authority of transit projects. The SSOA has oversight responsibilities of the project during Engineering and into revenue service. The SSOA typically reviews the project's safety and security related documents, including SSMP, SSCP, PHA, TVA, ITP, and final reports. The SSOA may conduct independent reviews prior to revenue service to evaluate safety and security readiness for operations. The SSOA is required to prepare a System Safety Program Standards (SSPS) that governs pre- and post- revenue requirements include:

- Transit agency preparation and implementation of a System Safety Program Plan (SSPP) and a System Security and Emergency Preparedness Plan (SEPP), which has replaced the document previously known as the System Security Plan (SSP)
- Safety certification activities
- Safety review of fixed guideway transit systems at least every three years
- Accident and incident investigation procedures
- Internal safety audit process
- Designation of an unacceptable hazardous condition, if warranted
- Developing and reporting on a corrective action program
- Safety monitoring
- Safety reporting

For additional information, consult:

☞ Implementation Guidelines for 49 CFR Part 659 [Ref. 2-49]

6.6 Security Oversight

Although FTA oversight of security operations is newer and somewhat less defined than its role in safety oversight, there are many parallels between the two. For additional information, Project Sponsors can consult both of the following resources:

- ☞ Implementation Guidelines for 49 CFR Part 659 [Ref. 2-49]
- ☞ The Public Transportation System Security and Emergency Preparedness Planning Guide [Ref. 2-53]

Sensitive Security Information should follow 49 CFR Part 15 and 49 CFR Part 1520.

6.7 Safety and Security Certification

An SSC certifies satisfactory compliance with a formal list of safety and security requirements of a transit capital project. Note that the word “safety” is used to deal with hazards (due to unintentional acts) and “security” to deal with vulnerabilities (due to intentional acts) The SSOA may oversee the SSC process from Design through testing and start-up, and conduct a pre-revenue service assessment prior to the initiation of revenue service. In other cases, the SSOA may allow the Project Sponsor to self-certify the project as ready for revenue operations. Either case warrants a detailed SSC.

For additional information, consult:

- ☞ Handbook for Transit Safety and Security Certification [Ref. 2-47].

. The SSC program typically encompasses the following categories:

- *Systemwide Elements* – May include the passenger vehicles, catenary, traction power, train control, voice and data communications, closed circuit television (CCTV) or other surveillance systems, grade crossing and traffic control, intrusion detection systems, central instrument houses, track, Fare Collection systems, supervisory control, fire protection and suppression systems, and auxiliary vehicles and equipment.

- *Fixed Facilities* – May include stations and shelter stops, pedestrian bridges, yards and shops, structures, and the control center. Equipment installed in stations or shelter stops such as HVAC systems, escalators, and elevators is also considered part of the facility.

- *Plans, Procedures, and Training* – May include items such as emergency preparedness plans, emergency evacuation routes, security plans and procedures, training programs, rulebooks, and standard operating procedures.

When properly scoped, the SSC program will:

- During project design:
  - Develop, document, and communicate safety and security criteria to guide design, engineering, and specification for the transit project.
  - Identify safety and security critical issues and develop practical and cost-effective requirements to support their resolution.
  - Use hazard and vulnerability analyses to evaluate the impact of all deviations introduced into the system in the form of engineering change proposals, construction change orders, work-arounds, and other temporary measures prior to the initiation of revenue service.
  - Develop management mechanisms to track and control the incorporation of safety and security into the transit project.
  - Identify certifiable items
  - Develop safety and security design criteria, including, possibly, a formal document that describes and lists the criteria
  - Develop and complete design criteria conformance checklist(s)
  - Perform construction specification conformance
  - Identify additional safety and security test requirements
- During procurement and construction:
  - Assure that safety and security requirements are adhered to at construction sites and that designated Project Sponsor personnel periodically check to assure continued compliance
  - Perform testing and validation in support of safety and security certification
- During testing and start-up:
  - Oversee management of integration tests for safety and security certification
  - Oversee management of pre-revenue operations safety and security certification
  - Verify operational readiness
  - Conduct final determination of project readiness and issue the final Safety and Security Certification Verification Report

While efforts toward final safety and security certification should begin early in the project development process to influence design to mitigate hazards, threats, and vulnerabilities, this effort will intensify during later phases of the project, especially during Construction and Testing and Start-up. The safety and security certification process should be guided by the Safety and Security Certification Checklist and should be overseen by the Safety and Security Certification Review Committee (SSCRC). This committee will most frequently be comprised of the following:

- System Safety Certification Manager (Chair)
- Senior Safety Manager
- Senior Security Manager
- Engineering Manager or General Engineering Consultant (GEC)
- Senior Operations Manager
- Senior Maintenance Manager
- Hazards and Vulnerability Experts, as required

The SSCRC should be supported by Project Sponsor staff and consultants involved in managing the implementation of the project, in addition to the following:

- *Fire-Life Safety Committee (FLSC)* – Serves as a liaison between the sponsor, fire jurisdictions, and emergency response agencies. The FLSC reviews standards and safety-related designs and tests to verify fire-life safety code and regulatory compliance. In addition, the FLSC addresses preparedness issues and reviews variances.

- *Configuration Management Committee or equivalent* – Serves as a liaison to the Project Sponsor's O&M functions and all departments related to operations planning, rules and procedures, training, and pre-revenue service; reviews and approves changes to the system and fixed facilities that affect O&M.

The Project Sponsor's chief executive should receive, review, and accept the Safety and Security Certification Verification Report (SSCVR) and sign the SSCR certificate for the project and then forward both to the SSOA.

6.8 Emergency Preparedness

The transit agency should establish strong ties with emergency response agencies and develop resources to provide for mutual assistance in support of transit emergencies. This is a two-way process. Typically, the Project Sponsor will implement the Fire Life Safety and Security Committee (FLSSC) to support regular coordination among the local first responding agencies. Just as the transit agency expects area emergency responders to be available when needed, the transit agency must be prepared to provide its resources to respond to community emergencies. Emergency preparedness requires working with local emergency management groups to develop procedures and contingency plans.

As part of the start-up of a new transit project, there should be specific plans developed to address the site-specific nature of the capital project. Prior to revenue operations, tabletop exercises and specific field drills should be performed depending on the nature and scope of the project. The FLSSC is often responsible for determining drill details and necessary involvement.

Examples of emergency readiness drills include the following simulations:

- Explosive device found on the system, whether detonated or not
- Fire and smoke on a railcar involving patron evacuation
- Fire, smoke, or other emergency condition in a station
- Grade crossing collision with injuries
- Underground toxic chemical release
- Patron evacuation on aerial structures and in tunnels
- Derailment

Important aspects related to an emergency drill include:

- Defining the roles and responsibilities of the people involved

- Having observers to critique the drill
- Having a drill debriefing to obtain feedback
- Producing a drill summary and using it as the basis of an after-action report and meeting attended by as many of the drill participants as possible
- Revising policies, procedures, training, etc., based on problems or inadequacies discovered as a result of the drill and properly recording and circulating the changes made
- Closing out the drill as a certification item through safety and security certification documentation
- Involving as many employees as possible, including non-operating staff who may become involved in field situations if an actual emergency were to occur; non-operating personnel should act the roles of injured patrons, bystanders, etc., to give them a realistic idea of what happens during a system emergency and how O&M, safety, and security personnel are expected to interact with outside agencies, patrons, bystanders, and the media

Many Project Sponsors videotape their drills to be used during after-action meetings and as a training aid, particularly for employees who did not attend the drill or were hired after the drill was conducted.

Emergency drills are specified and procedures contained in the ITP. They are performed during the SIT period to assure that agency and responder personnel are trained and capable of responding to an emergency should it occur during PRO. Emergency drills are certifiable items. As indicated above, they are often repeated to provide additional training during PRO.

6.9 Public Relations and Marketing

The Project Sponsor should conduct public outreach and an active public information program throughout the capital project development process. If the project relates directly to transit customers, especially for new or expanded service, this should include an intensive marketing campaign to encourage the public to utilize the new and/or improved service. The campaign should include specific information on how to use the new service including reoriented feeder bus service and park-and-ride facilities.

Particularly if the transit system is new or was originally met with negative public comments, the ease and safety of use should be stressed, as studies have shown that communities that were without public transit are often apprehensive about how the system may alter their neighborhood's cohesiveness. Public information campaigns should include schools, senior centers, and other local institutions that might also draw on the good will of community leaders and local elected officials.

A proactive public safety outreach program will include schools, senior centers, hospitals, and other public facilities that can be expected to encounter the transit system. Operation Lifesaver and other safety programs should be age-specific, particularly in areas where transit is new and where the tracks may traverse areas where free movement will not be curtailed. The program should also encompass security awareness elements such as Transit Watch, and emergency preparedness elements to inform riders of personal safety practices while riding transit and vehicle emergency evacuation instructions.

6.10 Initial Revenue Service

Project management concerns typically end at the conclusion of the Testing and Start-up Phase, except for the management of warrantee claims or the completion of "work-arounds" and removal of restrictions that may have been put in place to allow safe and secure revenue service while some non-client elements are brought into compliance with requirements. The RAC will remain active past the initiation of revenue operations solely to see satisfactory resolution of all work-arounds and removal of all operating restrictions.

The Project Sponsor should organize and pay close attention to the following during the Revenue Service phase to maintain a high level of system performance:

- A continuous quality improvement or lessons learned program
- A configuration management and change control process
- An SGR program within the framework of the department(s) responsible for facilities and vehicle maintenance
- A system capital replacement and modernization replacement fund – to obtain and install facilities, equipment, accessories, or appurtenances needed to maintain the system's capacity and performance

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INDEX

APPENDIX A – COST ESTIMATION METHODOLOGY

Introduction

Cost estimation is a process that provides progressively more accurate information as a project moves from conceptual through final design, award of construction and/or equipment/materials contracts, and updated as estimates to complete throughout such contracts until close-out. It establishes initial budget limits and is the crucial element of a project management/control system. FTA relies heavily on a Project Sponsor's ability to develop, monitor, tend, and update an accurate project budget. Over time, budget estimates are refined as more detailed engineering information is available.

Budget Development

Creating a project budget requires the allocation of all costs associated with completing a project. Project budgets are built from the "bottom up" by use of work breakdown structures (WBS). The WBS provides a means for defining program/project scope, both what is to be built – hard costs; and all management/administrative costs, including fees, testing, etc. – soft costs.

Development of an "order of magnitude" estimate marks the beginning of the budget and project management process. Project Sponsor staff (or, often, contracted design consultants) prepare "order of magnitude" estimates using models or templates developed by a professional engineering association having detailed knowledge of a particular field or industry. In rail transit, for example, a frequent starting place would be manuals published by the American Railway Engineering and Maintenance Association (AREMA) with adjustments reflecting unique features of the Project Sponsor's fixed guideway project. Another source is the "R. S. Means Construction Cost Estimating Manual." At this level of detail, higher levels of reserves or contingencies are normal.

> Hard costs are the probable costs of construction and procurement of equipment (and materials) and are first prepared as "order of magnitude" estimates. From this point the Project Sponsor engineering staff and retained design consultant is instructed to "design to budget", an exercise that relies on budget limits to control scope expansion. No construction contingencies are included at this level of detail. Project Sponsors do not release design contingencies at this stage of design, usually reserving these funds for added design work needed at a later time. In some circumstances an architect/engineer instructed to "design to budget" may be required to redesign a project, at no cost to the Project Sponsor, if construction bids exceed final design estimates. At the preliminary design, design development and final design stage, construction cost estimates should be verified at key milestones of progress to ensure that a project is remaining and has remained within budget.

Value engineering (VE) is encouraged by FTA throughout the design process, particularly in the early phase where there is the greatest opportunity to affect the cost of construction with minimal impact to project goals. VE assesses products and systems and provides recommendations for a more economical solution. The process also considers long-term operations and maintenance practices and costs.

Construction Planning and Constructibility Review are two other steps encouraged by FTA, beginning at or near the end of the Project Development (PD) Phase. In each case, it is essential to involve construction personnel along with the designers, cost estimators and schedulers, and to do so early and at least once again before the Engineering Phase and construction contract terms and conditions are far along to be effective. It is also useful to invite construction and equipment contractors to "industry review" workshops which address both of these subjects.

- As used here, as distinct though interrelated with project or contract schedule analysis and development, Construction Planning involves the broad assessment of the environment and conditions in and under which a particular construction contract (or the furnishing of a fixture or structure from an equipment contract) will be advanced. It seeks to understand the work site and adjacencies that are to be (or may be) impacted, the means and methods for essential site access, and associated constraints that are likely to be encountered. These elements can and will influence contractor interests and the bids, as well as the potential for disruptions, delays, claims and community disruption.

- Constructibility Review is a process whereby the plans and specifications are reviewed toward the goal of ensuring the project (contract package) is both "biddable" and "buildable". It seeks to bring experienced construction personnel together with the designer to evaluate the scope of the work to be bid, with attention to three major categories of concern: (1) can it be constructed using standard methods, materials and techniques as it is detailed in the plans and specifications; (2) can the bid documents made available to the contractor permit a competitive and cost effective bid; and (3) can the finished work be built according to the plans and specifications and meet the cost-effective maintainability envisioned by the Project Sponsor over its useful life.

There is any number of sources for further information on these topics, among them: American Association of State Highway and Transportation Officials' (AASHTO) Constructibility Review Best Practices Guide, August 2000; and the Association for the Advancement of Cost Engineering (AACE).

FTA *requires* its Project Sponsors to escalate construction costs to reflect anticipated inflation and to report this amount as a separate budget line item. This requirement acknowledges that over time, materials and labor costs may rise due to general inflation. Escalation may be calculated by applying an assumed fixed annual percentage to probable construction costs through the mid-point of construction. During the Final Design Phase, the more sophisticated approach must be used to apply escalation by either individual construction contract or by trade item, e.g. bridge, track, signal, etc., and adjust to the anticipated year of expenditure.

Large, complex projects that encompass many construction contracts should add a program contingency over and above design and construction contingencies. A program contingency addresses interfaces between and among construction contracts as well as uncertainty (risks) associated with system start-up, testing, and commissioning. FTA participates in reasonable startup costs that directly support activation and pre-revenue operations. These costs should be accounted for in the project estimate.

Recommendations

1. **Resolution of Variations in Cost Estimates** – During project development FTA and the Project Sponsor should agree on a method to resolve variances between estimates. FTA has utilized a Capital Reserve Account (CAPRA) for this purpose. The CAPRA requires the Project Sponsor to set aside funds equal to estimating differences. These funds are available for overruns.

2. **Cost Management System** – Project Sponsors must implement a cost management system to operate within the framework of the grant requirements and provide the Project Sponsor with reliable cost information every step of the way along the project development continuum. Greater visibility to cost information will permit the timely implementation of alternative solutions. The cost management system will encompass a data base of all project costs organized within the WBS.

   Reporting categories within the cost management system must be as explicit as possible so as to be able to measure performance of each participant organization (e.g., Project Sponsor, third parties, each professional services consultant, construction contractors, equipment or other supplies/services contractors, etc.) and should include:
   - Baseline budget authorization
   - Contract commitments
   - Actual cost
   - Pending contract changes
   - Forecast to complete
   - Estimate at completion
   - Budget variance
   - Earned value (cost and time relative to major milestones and logical interim milestones)

   Project Sponsors can manage the program/project contingency by evaluating commitments to budget estimates and tracking potential changes as soon as they are identified. Further, the Project Sponsor must establish a change order control system that identifies and records the cause of the changes. Increases/changes in scope or “scope creep” are a common occurrence on large-scale as well as small-scale projects. Individual changes should be logged and recorded with the appropriate funding source. The change procedures must be formalized and all changes should be reviewed by the cost estimator(s) and scheduler(s) for the project, not just the design management team.

3. **Cost Recovery** – In association with the change order control system, Project Sponsors are encouraged to develop and utilize a cost recovery procedure. Several larger projects have successfully implemented procedures that allow for the potential recovery of costs due to “errors and omissions” that cause rework of a portion of the project. It is a requirement of all design contracts for the Architect/Engineer to maintain professional and general liability insurance to cover these items. Regardless of how much is recovered through this process, it is an effective negotiation tool.

Table A-1. Recommended Contingency by Estimating Stage

Estimate Stage	***Probable Accuracy*[1]**	***Design Stage***	***Purpose***	***Information Available***	***Estimate Methods***	***Contingency Guideline***
Order of Magnitude (conceptual)	50% - 30%	Preliminary	Evaluation of projects or alternatives	100-scale alignment, facility descriptions, sketches, study reports	*Parametric* – Cost of a similar facility is adjusted to represent the new facility. Includes costing by SF, LF, or CF. *Model* – A typical design is used to develop quantities and costs for elements.	30% or higher
Preliminary (budget	15% - 30%	Preliminary Design Report (25%)	Establish Control Budget	40-scale alignment, facility descriptions, sketches, study reports, cross sections, profiles, elevations, geotechnical data, staging plans, schedule, definition of temporary work	Quantity development of major commodities, pricing by database, manuals, quotes, bid results, or experience which may be adjusted for the conditions of the specific package. Rough estimates or allowances developed for immeasurable items.	25% - 30%
Definitive	15% - 5%	75% to 100% complete	Detailed Control Budget, Cost Control, and Reporting	Progress Plans and Specifications, working construction schedule	Takeoff of quantities from plans, representative pricing by database, manuals, quotes, bid results, or experience adjusted for the conditions of the specific package. Crewed approach to labor and equipment, percent approach to general conditions, overhead and profit, contingency and escalation. Some allowances carried for immeasurable items.	15% - 20%
Detailed (engineer's estimate)	$\pm$ 5%	PS&E	Check Estimate for Bids, Commit Funds	Complete Plans and Specifications for Bidding, Detailed Construction Schedule, Contract Terms and Conditions	Detailed takeoff of all measurable items, detailed review of specifications, detailed pricing including price quotes, crewed approach to labor and equipment, detailed estimate of general conditions, overhead & profit, and escalation. Consideration of construction schedule, work restrictions, shift requirements, and risk.	10% - 15%

[1] Probable Accuracy as stated by the Association for the Advancement of Cost Engineering International (AACE)

APPENDIX B – PROJECT CONTINGENCY (GENERAL OVERVIEW)

Definitions

Congress has directed that funds sufficient to meet "project contingencies" be included in all Full Funding Grant Agreement (FFGA) New Starts budgets. Annually in the Department's Appropriation Statute, or the accompanying Congressional Conference Report, the importance of this budget item is reinforced. Contingency levels vary depending on the complexity of the project, the experience of the Project Sponsor with similar projects, the contract packaging, the project schedule, and, of course, how well the project has controlled costs (and schedule) during development and is defined through engineering plans and specifications at the time bids are solicited.

For the two most common contract choices employed by Project Sponsors – design/bid/build and design/build – the burden of risk is very different. In either case, how the Project Sponsor identifies and distributes risks among the parties also will influence contingencies required. Contingency is typically broken into allocated and unallocated contingencies. Total project contingency is the sum of the two and almost always expressed as a percentage of the overall estimated cost of the project.

The companion Appendix E to this document consists of a guidelines document the FTA has had developed that discusses in great detail the risk assessment process and in turn a Risk and Contingency Management Plan (RCMP) that is required for all New Starts projects.

Design/Bid/Build

Design-bid-build (D/B/B) projects demand a larger percentage for contingency in relation to the overall project budget because the owner is assuming the majority of risk. Total project contingency for D/B/B contracts typically average around 10% or higher of the overall project budget at the 100% bid point. Consequently, higher contingency is required prior to bidding any of the work so as to reflect realities of the design phases and the potential market conditions upon bidding. For traditional D/B/B projects, the owner provides the contractor with plans and specifications, and the contractor provides a bid to build the project. Any changes to the project become the sole responsibility of the owner and may impact schedule and budget. Changes on D/B/B construction projects are most often the result of changed conditions, design errors, or additional requirements.

Typically in a D/B/B contract the design consultant maintains a significant manpower level in order to review contractor submittals and perform design activities associated with any errors, differing site conditions and/or new program requirements. Most changes add cost to the project budget. Generally the amount of contingency assigned to a project budget declines as a project nears completion. There are exceptions, particularly if a large number of change orders and claims are outstanding.

Design/Build

In a design/build (D/B) contract design activity is integrated into the construction contract. There is only a limited need to transfer data across contract boundaries, particularly for approval on a day-to-day basis. Since the D/B contractor is responsible for design and construction, it has assumed the most, if not all, risks for differing site conditions and design errors. Whenever changes are ordered or new requirements established the Project Sponsor or third parties, the risks and costs are normally the owner's. The presence of a third party with authority to order change has the potential to increase costs and this situation must, therefore, be carefully managed. The owner will normally control internally generated changes and limit financial risk. With only third party changes to plan for, construction contingency can be closer to 10%.

Other Related Issues

Project endeavors such as ROW purchase/relocation, vehicles acquisition, project management, construction management and miscellaneous construction, utility and startup efforts for design/build contracts typically have nearly the same risks as a design/bid/build contract, but rarely have exceeded one third of the total project costs. Co-location of the owner and D/B contractor, as compared to the traditional arrangement in which project participants are often located in separate facilities, has proven to speed resolution of questions and improved project execution.

Managing Risk

The amount of project contingency is directly related to the risk associated with completing a particular scope of work. This is true in the design phases as well as in construction and other procurements. Contractors when bidding on a project evaluate risk and incorporate its potential cost into their bid. If a contractor's contingency is not used it will become profit to the contractor.

If bid documents are, or a Request for Proposal (RFP) is, ambiguous the result will likely be bids higher than expected. Bid documents or an RFP that clearly defines the project, its operational/quality requirements, and explicitly states how the bids or proposal will be evaluated, generally results in a bid or proposal that will best meet the needs of the owner. This minimizes the risk of changes, and the cost associated with those changes, and reduces the amount of contingency needed by the contractor.

APPENDIX C – CHECKLIST - READINESS TO ENTER ENGINEERING

Even before entry into the Engineering phase, a project must have sufficient design detail to be considered for a FTA Capital Investment Grant program. The checklist below (drawn from FTA draft guidance of September 2015) lists FTA review criteria used to determine project readiness for entry into Engineering.

Item	Description	Item Detail
1.0	**PROJECT DEFINITION**	
1.1	**System Definition**	
1.1.1	Alignment Definition	General alignment is defined to include the approximate horizontal and vertical alignment, approximate station locations, and length. The alignment should be developed beyond the definition contained in the LPA to describe all structures necessary for the project. Minor alternative alignments may be evaluated within the corridor, as required, to the degree they are within the LPA definition.
1.1.2	Configuration Management Plan	Configuration Management should document the process of managing the physical configurations and their supporting processes through documents, records and data. Configuration Management should demonstrate a process that accommodates changes and continually documents how a physical system is configured, ensuring that documents, records, and data remain concise and valid.
1.1.3	Station requirements	Station design characteristics including station locations and station sizing. Should identify platform lengths and support spaces for mechanical/electrical equipment.
1.2	**Environmental Constraints**	
1.2.1	NEPA	NEPA requirements for entry into Engineering include preparation of an EIS where effects from a proposed project are significant or a Finding of No Significant Impact (FONSI) and accompanying environmental assessment (EA) where effects are less than significant. For an EIS, FTA approves the preferred project through issuance of a Record of Decision (ROD). The ROD describes the scope of the projected and committed mitigations to reduce the effects of identified impacts.
1.2.2	Third party requirements	(1) Evaluate third-party agreement processes and current status of agreements. Where agreements are not available, Project Sponsor should provide an outline or term sheet(s). When even this information is not available, the needed agreement shall be identified and the issues and any obstacles to executing the agreements noted.
		(2) Types of agreements and information to be reviewed include, but are not limited to: ▪ utility relocation agreements (public-water, sewer, etc.) ▪ intergovernmental agreements (IGA) with local entities ▪ agreements with railroad companies (design, construction, operating) ▪ third-party franchise agreements (gas, telephone, cable TV, other communications, power);
		▪ universities, colleges, other educational institutions agreements ▪ public/private funding arrangements (including transit-oriented development - TOD) ▪ Master permitting plan and schedule

Item	Description	Item Detail
		(3) The framework and content of these agreements must conform to the needs of the project. Agreements should be negotiated and completed to the extent possible prior to start of Engineering Phase; where incomplete, a defined process for achieving completion is in place.
1.2.3	Geotechnical Baseline	Geotechnical baseline report prepared for projects involving tunnels or other underground structures, or where specific structures (e.g., major bridges, retaining walls, levees, or other facilities) will be located on material with questionable or unknown load bearing capacity.
2.0	**PROJECT MANAGEMENT PLAN**	
2.1	Basis of project documented	*Note: Some of the items listed are repeated below where additional review guidance is provided.* (1) FTA's regulations are found in 49 CFR 633.25, which requires a Project Management Plan to contain at a minimum the following: (a) A description of adequate recipient staff organization, complete with well-defined reporting relationships, statements of functional responsibilities, job descriptions, and job qualifications; (b) A budget covering the project management organization, appropriate consultants, property acquisition, utility relocation, systems demonstration staff, audits, and such miscellaneous costs as the recipient may be prepared to justify (Note: budget should also address design, construction, and start-up/commissioning); (c) A construction schedule (Note: schedule should address entire project from design through revenue operations); (d) A document control procedure and recordkeeping system; (e) A change order procedure which includes a documented, systematic approach to the handling of construction change orders (Note: should also address change orders for all procurements); (f) A description of organizational structures, management skills, and staffing levels required throughout the construction phase (Note: budget should also address design, construction, and start-up/commissioning); (g) Quality control and quality assurance programs which define functions, procedures, and responsibilities for construction and for system installation and integration of system components (Note: QA/QC program should also address design, procurement, and start- up/commissioning); (h) Material testing policies and procedures; (i) Plan for internal reporting requirements including cost and schedule control procedures; and (j) Criteria and procedures to be used for testing the operational system or its major components;"
		(2) Legal authority for project (3) The FTA or its PMOC may recommend a workshop be held to help establish roles and responsibilities and define baseline standards of performance related to the management of the project. Few, if any, Project Sponsors have all the capabilities or authorities to plan, design, and implement a major capital project by themselves. Bringing Project Sponsor staff, consultants, and relevant third parties together in a workshop early in the project life can help to shape the project management approach. Through workshop discussions, all parties can gain a better understanding of each other's requirements, responsibilities, and authorities as related to the project. The PMOC will review and summarize its findings and opinions and present recommendations with respect to the adequacy and soundness of the Project Sponsor's plans and procedures, and the successful implementation of such plans and procedures for:

Item	Description	Item Detail
		• NEPA coordination – The Project Sponsor's plan for managing and implementing mitigation actions should be in place and environmental mitigation work should be incorporated into the design documents, cost estimates, and schedules. • Design control. The Project Sponsor should implement appropriate plans and procedures for design control in all aspects. These plans and procedures should illustrate: ▪ consistency with design criteria; ▪ coordination and change control among design disciplines for drawings and specifications; ▪ completeness of soils testing and site surveys; ▪ coordination with third parties; and ▪ completeness of project documents for bidding.
		(4) The Project Management Plan should provide for implementation of project controls in all aspects including procedures for cost and schedule control, risk management, and dispute or conflict resolution during construction. The PMP should include procedures on cost sharing. Risk and contingency management policies and procedures should be in place and routinely used.
		(5) The PMP should confirm implementation of plans and procedures for project delivery and procurement. Specifically, it should focus on the schedule for bidding construction packages and procuring equipment and vehicles.
		(6) Labor Relations and Policies should be in development.
		(7) Development should be underway for plans and procedures regarding construction administration, construction management, construction inspection, coordinating construction work by third parties, site logistics, and construction change order and shop drawing document flow and authorities.
		(8) Development of Start-up and Revenue Operations should be underway to establish plans and procedures regarding testing/commissioning, closeout of construction contracts, and training of staff.
		(9) PMP Subplans should include the Quality Assurance / Quality Control Plan, Safety and Security Management Plan, Real Estate Acquisition Management Plan, and Bus and Rail Fleet Management Plans.
2.2	Environmental mitigation/ assessment documented	(1) Description of Mitigation Principles
		(2) Plan for Management and Implementation of Mitigation Actions
2.3	Design Procurement and Control Plan	(1) Design contracting plan for the Engineering Phase
		(2) Description of relationship between forecast ridership, operating plan and proposed project transit capacity in guideways, stations, support facilities
		(3) Design Criteria for each discipline
		(4) Schedule for the development of contract documents (level of development expected at each milestone for design/construction drawings, specifications, general and supplementary conditions of contracts for construction, and the Division 1)
		(5) Plan / procedures for Design Drawings and Specifications
		(6) Procedures for Design Change and Configuration Control of documents during Design and Construction
		(7) Plan (List and schedule) for third party agreements and permits including utilities, real estate, railroads, transit-oriented development/joint development, etc.

Item	Description	Item Detail
		(8) Investigation and Testing Plan (List and schedule) for site surveys, geotechnical and materials investigation before/during design.
2.4	Project Controls	(1) Document and Records Controls
		(2) Internal reporting procedures
		(3) Cost Control Procedures
		(4) Schedule Control Procedures
		(5) Risk Control Procedures
		(6) Dispute / Conflict Resolution Plan (claims avoidance and claims resolution)
2.5	Project construction delivery and procurement plan	(1) Procedures for Procurement
		(2) Procurement Plan and Schedule
		(3) Contracting Strategy for Transit- Oriented Development and Joint Development, if applicable
		(4) Identification of Disadvantaged Business Enterprises (DBE) Opportunities, Federal DBE, State/Local WBE & MBE, Plans and Goals
		(5) Negotiating and Approving Change Orders and Claims
		(6) Procedures for claims avoidance
2.6	Labor relations and Policies	(1) Wage Rates and Classifications
		(2) Wage and Hour Requirements
		(3) State and Local Regulations
2.7	Construction Procedures for Fixed Infrastructure	(1) Construction Contract Administration
		(2) Construction Management
		(3) Construction Inspection
		(4) Coordination with Third Parties
		(5) Site Logistics Plan (materials transport and storage; temporary site facilities; maintenance of existing pedestrian ways, transit and traffic operations during construction; protection of existing utilities)
		(6) Processing Shop Drawings, Bulletins, and RFIs
		(7) Substantial Completion; Final Completion
2.8	Start up and Revenue Operations	(1) Testing plan elements are identified and would be expanded at a later date
		(2) Closeout materials (warranties, testing results, O&M manuals, spare parts, etc.) to be identified to provide direction to the Engineer
		(3) Plan for Training of Staff to be developed later
2.9	QA/QC Plan	At entry to Engineering, the QAP shall fully address all elements governing project activities through the design phase. It should also contain, at least in outline form and to the level of detail possible, information relative to the upcoming construction phase. The PMOC shall also confirm that the Project Sponsor has exhibited both a Quality Assurance and Quality Control review of its PD package.
2.10	Safety and Security Management Plan	In place and is in compliance with FTA guidance as provided in Circular C5800.1. Preliminary Hazard Analysis (PHA) and Threat and Vulnerability Assessment (TVA) are complete. Safety and Security Design Criteria development is underway.
2.11		(1) Conforms with and is expressly incorporated within the Design Drawings, Master Schedule and budget for all

Item	Description	Item Detail
	Real estate Acquisition and Relocation Plan	phases and types of work planned or anticipated. Further, the RAMP must meet all federal requirements. The Project Sponsor is to provide a complete list of all parcels with title searches on all properties to be acquired and RAMP procedures.
		(2) Preparation of a relocation plan to include interviews with potential displacees which stresses that displacees are not to move until project plans have been finalized.
		(3) Project Sponsor shall exhibit management capacity and capabilities to implement the real estate acquisition and relocation process, including organization structure and staffing plan and any consultant agreements undertaken in support of these activities.
2.12	Rail and Bus Fleet Management	Plan demonstrates consistency with the project scope, NEPA documents, and the project's Operations Plan.
2.13	Before and After Study Documentation	Plan submitted in accordance with FTA guidance; verify that the plan has preserved the project scope and capital cost information.
3.0	**MANAGEMENT CAPACITY AND CAPABILITY**	
3.1	Organizational charts	Project organization charts show the complete organization, covering all project functions and all project personnel, regardless of affiliation. Staffing levels should be indicated. Charts should be time-oriented to show different organizational arrangements for different phases of the project.
3.2	Staff qualifications / Experience chart	Key personnel in all organizations should be identified and their principal duties, reporting relationships, job descriptions, job qualifications, and assigned responsibility and delegated authority should be defined. The size, qualifications, and availability of new and existing staff resources must be considered in relation to the human resource requirements and duration of the project. A responsibility matrix should be developed that identifies critical management activities and demonstrates the staff's ability to satisfy these requirements.
3.3	Staffing plan	Staffing levels should be indicated. Charts should be time-oriented to show different organizational arrangements for different phases of the project. The organization chart should be supplemented with a tabular staffing plan that shows percent utilization, mobilization start date, and release date (where applicable) information.
3.4	Engineering/Design Consultants	During construction planning, careful examination of the existing labor situation has determined the impacts of DBE participation.
3.5	Agency-level processes and procedures	Should include project management policies and procedures and an adequate staff of professionals skilled in but not limited to, project controls, QA/QC, cost estimation, scheduling, procurement, change control, risk management, transit operations, and public participation.
3.6	Resumes of project team members	Resumes should be provided for both agency and consultant **key staff.** Resumes must demonstrate experience and ability to manage each of the following key project areas: ▪ Project management ▪ Environmental assessment and mitigation leads ▪ Operations planning, Fleet management lead ▪ Design team leads ▪ Quality assurance and Quality control lead

Item	Description	Item Detail
		▪ Project controls leads ▪ Construction, permits, testing, start-up leads ▪ Real estate lead ▪ Safety review lead
4.0	**SCOPE**	
4.1	Scope Development	(1) Definition of the project (i.e., scope) contained in the project ROD/FONSI and most recent New Starts submittal agree with the scope as developed in Project Development materials, including the approved PMP and the engineering design plans and specifications. Discrepancies or unclear scope items in the plans should be noted
		(2) Basic quantities, such as number and locations of facilities, peak and total vehicles, etc., identified in the environmental document and ROD/FONSI are the same as assumed in the current project definition
		(3) The current project design satisfies the capacity and operational objectives established in the approved environmental document.
		(4) Mitigations committed to in the ROD (or project mitigation plans), when involving a physical or operational feature of the project, are incorporated - or in the process of being incorporated - into the engineering design, proposed construction program, and/or other implementation
		plans. Mitigations could include changes in design, use of different types of material, modified traffic control, restricted construction activities, etc.
		(5) Results of the hazard and threat and vulnerability analyses are incorporated in the design criteria and the scope of work.
4.2	Design Package	A Basis of Design Report is required which presents the following content: (1) Project Sponsor accepted design standards and performance objectives including consistency with the required transit capacity.
		(2) Design, construction, system and vehicle interfaces are well known and defined. Vehicle dynamic clearance and structure clearance diagrams are prepared.
		(3) Design Reports, Concept of Operations Report, and configuration studies are adequate and complete.
		(4) Design packages and contract packages are defined and delineated.
		(5) The documents possess a level of definition, clarity, presentation and cross-referencing consistent with the scope definitions in following sections.
		(6) The project is constructible. Adequate construction access and staging areas are identified.
4.3	Project Delivery Method Plan	Procedures for Procurement (advertising, bidding, awarding of contracts for consultants and construction contractors, procurement for equipment, etc.) are established including: Procurement Plan and Schedule (indicate project phase, durations for RFP, screening, interviews, selection, board approvals, etc.); Contracting Strategy for Transit-oriented and Joint Development; and identification of Disadvantaged Business Enterprises (DBE) Opportunities and Federal DBE and State/Local WBE & MBE Plans and Goals.
4.4	Constructability	Project Sponsor's construction planning of the project has sufficiently and adequately addressed the constructability of the project. An in-depth constructability review is required of the Project Sponsor. It is a critical tool for synthesizing the preliminary design work.

Item	Description	Item Detail
4.5	Site and Geotechnical Conditions	(1) Digitized aerial photogrammetry (aerial photo background; planimetric and topographic mapping) is complete.
		(2) Photo simulations and/or schematic renderings are available for stations, samples of the alignment, and unique features of the line.
		(3) Preliminary geotechnical investigations are complete including a subsurface exploration or laboratory testing program. Requirements for additional geotechnical investigations have been defined and identification of buried structures and utilities and identification of contaminated soils and other hazardous materials are complete.
4.6	SCC 10 Guideway	(1) Major or critical design decisions have been researched and decided including location and extent of elevated or underground structures, rehabilitation or reuse of any existing infrastructure, structures, facilities, or systems.
		(2) The choice of track or roadway design has been made for the line. Grade crossing construction is defined and clearances established for operations, maintenance, and emergency evacuation. Guideway drainage has been defined. emergency evacuation. Guideway drainage has been defined.
		(3) Major or critical work details, structural element dimensions, design interfaces, and physical interfaces have been identified and are defined in terms of drawings, standards, criteria, specifications.
		(4) Structural systems are established. Aerial guideway is dimensioned to show number of spans, span length, substructure design, etc.
		(5) Preliminary mass balance diagrams have been developed for vertical alignments on fill or cut supported by topographic surveys and soil investigations.
		(6) Retaining walls and fills are located and dimensioned and defined in terms of drawings, standards, criteria, specifications.
		(7) Tunnels, both cut-and-cover and mined, are defined in terms of access and egress, construction access and laydown, openings for stations, passage chambers, ventilation or emergency access shafts or adits, sections, and profiles to depict and dimension major tunnel features. Tunnel design and dimensions have been cross checked to adjacent building foundations and coordinated with the vehicle's dynamic envelope, walkways and egress, tunnel lighting, and systems elements such as ventilation, communications, and traction power.
		(8) Trackwork is advanced to a level where single line schematics of the track layout, plan and profile drawings, dimensioned layouts of turnouts and crossovers, and tabulations of track geometry (horizontal and vertical curve data) have been defined. The alignment of any tunnel structure is referenced to the center line of track and base of rail. Guideway sections, inclusive of aerial, tunnel and station cross sections, consistently show the distance from centerline of track to critical clearance points such as walls, walkways, and edges of platforms.
		(9) Special trackwork is located and adequately defined.
		(10) Where used, the contact rail system is specified with typical details and required clearances provided. End ramps and anchors are located. Gaps are coordinated with the traction power supply system. Feeder and return conductor attachment are specified and typical details provided.
		(11) The need for special track construction for noise or vibration control is identified with locations and preliminary dimensions and a preliminary choice is made for the noise and vibration control design.
4.7	SCC 20 Stations, Stops, and Terminals	(1) Major or critical design decisions have been researched and decided including rehabilitation or reuse of any existing structures, facilities or systems. Major or critical operational fire/life safety, and security requirements

Item	Description	Item Detail
		have been defined. Interfaces with other transit facilities or structures are identified and passenger and public circulation concepts defined.
		(2) Station architecture is established. The drawing package consists of site plans and, for station buildings, floor plans, elevations, longitudinal and cross sections, and details illustrating typical and special architectural conditions. The finish concept should be clearly described.
		The location and outline of fare gates and barriers should be shown. The location of ticket vending machines, electronic passenger information displays, security systems and other platform amenities should be shown.
		(3) Within the site context, the building footprints are shown. The relationship of the building to grade and to adjacent facilities is clearly defined, as is provision for pedestrians and bicycles to access the public way from the building. Provision for motorized vehicles is also shown. Access to the platforms and buildings and within the buildings complies with ADA. Any parking lots or structures are shown.
		(4) Building sections and elevations illustrate the relationship of the station to grade (below, on- grade, elevated structure); the building structural system has been chosen and preliminary dimensions established for clearances.
		(5) Station building floor plans show vertical circulation systems including stairs, elevators, escalators, and support spaces for mechanical, plumbing, electrical, and communications systems. The floor plans should show the agent area, fare gate area, retail areas, and any crew or public facilities.
		(6) Level boarding between the transit vehicle and the boarding platform complies with ADA. Documentation shows passenger level boarding design for all stations and/or satisfactory determination of infeasibility for one or more stations along with a satisfactory alternative plan for accessibility.
		(7) Preliminary identification of arts-in-transit integrated into station design.
		(8) Electrical systems should include a single line drawing including the source and distribution of power. Mechanical and electrical systems, including area drainage, piped utilities, heating ventilation and air conditioning, smoke evacuation, power, and lighting, are described and single line drawings are provided.
		(9) Design interfaces among disciplines are defined on drawings, in standards, design criteria, specifications and contract package scopes.
		(10) Parking structure design is progressed to a level consistent with station buildings as described above including vertical transportation and interface with the station buildings. Parking design is consistent with Record of Decision.
4.8	SCC 30 Support Facilities: Yards, Shops, Administration Buildings	(1) Major or critical design decisions have been researched and decided including rehabilitation, reuse or expansion of any existing structures, facilities or systems. Major or critical operational fire/life safety, and security requirements have been defined.
		(2) An architectural space program has been prepared for all occupied buildings including for modifications to existing buildings such as Control Centers. The support facility drawings are consistent with the architectural program. Adequate employee parking is provided.
		(3) Based on the vehicles chosen and utilization as set out in the fleet management plans, a review has been done to determine the number of vehicle spots and facilities (jacks, wheel truing, etc.) required.
		(4) A preliminary industrial engineering evaluation has been prepared for all workspaces in shops

APPENDIX D – CHECKLIST – READINESS TO EXECUTE SSGA/FFGA

To be considered for the FTA Capital Investment Grant program, a project should have sufficient design detail. The checklist below (drawn from FTA draft guidance of September 2015) lists FTA review criteria used to determine project readiness for execution of a Full Funding Grant Agreement (FFGA) or Small Starts Grant Agreement (SSGA).

Item	Description	Item Detail
1.0	**PROJECT DEFINITION**	
1.1	**System Definition**	
1.1.1	Alignment Definition	Alignment is defined to include the horizontal and vertical alignment, station locations, and length. The alignment should be developed beyond the definition contained in the NEPA documents to describe all structures necessary for the project.
1.1.2	Configuration Management Plan	Configuration Management should document the process of managing the physical configurations and their supporting processes through documents, records and data. Configuration Management should demonstrate a process that accommodates changes and continually documents how a physical system is configured, ensuring that documents, records, and data remain concise and valid.
1.1.3	Station requirements	Station design characteristics including station locations and station sizing. Should identify platform lengths and support spaces for mechanical/electrical equipment.
1.2	**Environmental Constraints**	
1.2.1	NEPA	NEPA requirements include preparation of an EIS where effects from a proposed project are significant or a Finding of No Significant Impact (FONSI) and accompanying environmental assessment (EA) where effects are less than significant. For an EIS, FTA approves the preferred project through issuance of a Record of Decision (ROD). The ROD describes the scope of the projected and committed mitigations to reduce the effects of identified impacts.
1.2.2	Third party requirements	(1) Evaluate third-party agreement processes and current status of agreements. Note that all signed third party agreements are required prior to a FFGA/SSGA, unless there is a specific agreement between the FTA and the Project Sponsor that execution of certain agreements may occur after FFGA/SSGA.
		(2) Types of agreements and information to be reviewed include, but are not limited to: ▪ utility relocation agreements (public-water, sewer, etc.) ▪ intergovernmental agreements (IGA) with local entities ▪ agreements with railroad companies (design, construction, operating) ▪ third-party franchise agreements (gas, telephone, cable TV, other communications, power); ▪ universities, colleges, other educational institutions agreements ▪ public/private funding arrangements (including transit-oriented development - TOD) ▪ Master permitting plan and schedule
		(3) The framework and content of these agreements must conform to the needs of the project. Note that all signed third party agreements are required prior to an FFGA/SSGA, unless there is a specific agreement between the FTA and the Project Sponsor that execution of certain agreements may occur after

Item	Description	Item Detail
		FFGA/SSGA.
1.2.3	Geotechnical Baseline	Geotechnical baseline report prepared for projects involving tunnels or other underground structures, or where specific structures (e.g., major bridges, retaining walls, levees, or other facilities) will be located on material with questionable or unknown load bearing capacity.
2.0	**PROJECT MANAGEMENT PLAN**	
2.1	Basis of project documented	*Note: Some of the items listed are repeated below where additional review guidance is provided.* (1) FTA's regulations are found in 49 CFR 633.25, which requires a Project Management Plan to contain at a minimum the following: (a) A description of adequate recipient staff organization, complete with well-defined reporting relationships, statements of functional responsibilities, job descriptions, and job qualifications; (b) A budget covering the project management organization, appropriate consultants, property acquisition, utility relocation, systems demonstration staff, audits, and such miscellaneous costs as the recipient may be prepared to justify (Note: budget should also address design, construction, and start-up/commissioning); (c) A construction schedule (Note: schedule should address entire project from design through revenue operations); (d) A document control procedure and recordkeeping system; (e) A change order procedure which includes a documented, systematic approach to the handling of construction change orders (Note: should also address change orders for all procurements); (f) A description of organizational structures, management skills, and staffing levels required throughout the construction phase (Note: budget should also address design, construction, and start-up/commissioning); (g) Quality control and quality assurance programs which define functions, procedures, and responsibilities for construction and for system installation and integration of system components (Note: QA/QC program should also address design, procurement, and start- up/commissioning); (h) Material testing policies and procedures; (i) Plan for internal reporting requirements including cost and schedule control procedures; and (j) Criteria and procedures to be used for testing the operational system or its major components;"
		(2) Legal authority for project
		The PMOC will review and summarize its findings and opinions and present recommendations with respect to the adequacy and soundness of the Project Sponsor's plans and procedures, and the successful implementation of such plans and procedures for NEPA coordination – The Project Sponsor's plan for managing and implementing mitigation actions should be in place and environmental mitigation work should be incorporated into the design/contract documents, cost estimates, and schedules. (3) Design control. The Project Sponsor should implement appropriate plans and procedures for design control in all aspects. These plans and procedures should illustrate: (a) consistency with design criteria; (b) coordination and change control among design disciplines for drawings and specifications; (c) completeness of soils testing and site surveys; (4) coordination with third parties; and completeness of project documents for bidding.
		(4) The Project Management Plan should provide for implementation of project controls in all aspects including

Item	Description	Item Detail
		procedures for cost and schedule control, risk management, and dispute or conflict resolution during construction. The PMP should include procedures on cost sharing. Risk and contingency management policies and procedures should be in place and routinely used.
		(5) The PMP should confirm implementation of plans and procedures for project delivery and procurement. Specifically, it should focus on the schedule for bidding construction packages and procuring equipment and vehicles.
		(6) Labor Relations and Policies.
		(7) Plans and procedures regarding construction administration, construction management, construction inspection, coordinating construction work by third parties, site logistics, and construction change order and shop drawing document flow and authorities.
		(8) Development of Start-up and Revenue Operations should be underway to establish plans and procedures regarding testing/commissioning, closeout of construction contracts, and training of staff.
		(9) PMP Subplans should include the Quality Assurance / Quality Control Plan, Safety and Security Management Plan, Real Estate Acquisition Management Plan, Bus and Rail Fleet Management Plans and Risk and Contingency Management Plan.
2.2	Environmental mitigation/ assessment documented	(1) Description of Mitigation Principles
		(2) Plan for Management and Implementation of Mitigation Actions
2.3	Design Procurement and Control Plan	(1) Design contracting plan for the FFGA/SSGA Phase
		(2) Description of relationship between forecast ridership, operating plan and proposed project transit capacity in guideways, stations, support facilities
		(3) Design Criteria for each discipline
		(4) Schedule for the development of contract documents (level of development expected at each milestone for design/construction drawings, specifications, general and supplementary conditions of contracts for construction, and the Division 1)
		(5) Plan / procedures for Design Drawings and Specifications
		(6) Procedures for Design Change and Configuration Control of documents during Design and Construction
		(7) Plan (List and schedule) for third party agreements and permits including utilities, real estate, railroads, transit-oriented development/joint development, etc.
		(8) Investigation and Testing Plan (List and schedule) for site surveys, geotechnical and materials investigation before/during design.
2.4	Project Controls	(1) Document and Records Controls
		(2) Internal reporting procedures
		(3) Cost Control Procedures
		(4) Schedule Control Procedures
		(5) Risk Control Procedures
		(6) Dispute / Conflict Resolution Plan (claims avoidance and claims resolution)
2.5	Project construction delivery and procurement plan	(1) Procedures for Procurement
		(2) Procurement Plan and Schedule
		(3) Contracting Strategy for Transit- Oriented Development and Joint Development, if applicable

Item	Description	Item Detail
		(4) Identification of Disadvantaged Business Enterprises (DBE) Opportunities, Federal DBE, State/Local WBE & MBE, Plans and Goals
		(5) Negotiating and Approving Change Orders and Claims
		(6) Procedures for claims avoidance
2.6	Labor relations and Policies	(1) Wage Rates and Classifications
		(2) Wage and Hour Requirements
		(3) State and Local Regulations
2.7	Construction Procedures for Fixed Infrastructure	(1) Construction Contract Administration
		(2) Construction Management
		(3) Construction Inspection
		(4) Coordination with Third Parties
		(5) Site Logistics Plan (materials transport and storage; temporary site facilities; maintenance of existing pedestrian ways, transit and traffic operations during construction; protection of existing utilities)
		(6) Processing Shop Drawings, Bulletins, and RFIs
		(7) Substantial Completion; Final Completion
2.8	Start up and Revenue Operations	(1) Testing plan elements are identified and would be expanded at a later date
		(2) Closeout materials (warranties, testing results, O&M manuals, spare parts, etc.) to be identified to provide direction to the Engineer
		(3) Plan for Training of Staff
2.9	QA/QC Plan	The QAP shall fully address all elements governing project activities through the design phase. The PMOC shall also confirm that the Project Sponsor has exhibited both a Quality Assurance and Quality Control review of its Engineering package.
2.10	Safety and Security Management Plan	In place and is in compliance with FTA guidance as provided in Circular C5800.1. Preliminary Hazard Analysis (PHA) and Threat and Vulnerability Assessment (TVA) are complete. Safety and Security Design Criteria development is complete.
2.11	Real estate Acquisition and Relocation Plan	(1) Conforms with and is expressly incorporated within the Design Drawings, Master Schedule and budget for all phases and types of work planned or anticipated. Further, the RAMP must meet all federal requirements. The Project Sponsor is to provide a complete list of all parcels with title searches on all properties to be acquired and RAMP procedures.
		(2) Preparation of a relocation plan to include interviews with potential displacees which stresses that displacees are not to move until project plans have been finalized.
		(3) Project Sponsor shall exhibit management capacity and capabilities to implement the real estate acquisition and relocation process, including organization structure and staffing plan and any consultant agreements undertaken in support of these activities.
2.12	Rail and Bus Fleet Management	Plan demonstrates consistency with the project scope, NEPA documents, and the project's Operations Plan.
2.13	Before and After Study Documentation	Plan submitted in accordance with FTA guidance; verify that the plan has preserved the project scope and capital cost information (may not be required for Small Starts projects).

Item	Description	Item Detail
3.0	**MANAGEMENT CAPACITY AND CAPABILITY**	
3.1	Organizational charts	Project organization charts show the complete organization, covering all project functions and all project personnel, regardless of affiliation. Staffing levels should be indicated. Charts should be time-oriented to show different organizational arrangements for different phases of the project.
3.2	Staff qualifications / Experience chart	Key personnel in all organizations should be identified and their principal duties, reporting relationships, job descriptions, job qualifications, and assigned responsibility and delegated authority should be defined. The size, qualifications, and availability of new and existing staff resources must be considered in relation to the human resource requirements and duration of the project. A responsibility matrix should be developed that identifies critical management activities and demonstrates the staff's ability to satisfy these requirements.
3.3	Staffing plan	Staffing levels should be indicated. Charts should be time-oriented to show different organizational arrangements for different phases of the project. The organization chart should be supplemented with a tabular staffing plan that shows percent utilization, mobilization start date, and release date (where applicable) information.
3.4	Engineering/Design Consultants	During construction planning, careful examination of the existing labor situation has determined the impacts of DBE participation.
3.5	Agency-level processes and procedures	Should include project management policies and procedures and an adequate staff of professionals skilled in but not limited to, project controls, QA/QC, cost estimation, scheduling, procurement,
3.6	Resumes of project team members	Resumes should be provided for both agency and consultant **key staff.** Resumes must demonstrate experience and ability to manage each of the following key project areas: ▪ Project management ▪ Environmental assessment and mitigation leads ▪ Operations planning, Fleet management lead ▪ Design team leads ▪ Quality assurance and Quality control lead ▪ Project controls leads ▪ Construction, permits, testing, start-up leads ▪ Real estate lead ▪ Safety review lead
4.0	**SCOPE**	
4.1	Scope Development	(1) Definition of the project (i.e., scope) contained in the project ROD/FONSI and most recent New Starts submittal agree with the scope as developed in Engineering Phase materials, including the approved PMP and the engineering design plans and specifications. Discrepancies or unclear scope items in the plans should be noted
		(2) Basic quantities, such as number and locations of facilities, peak and total vehicles, etc., identified in the environmental document and ROD/FONSI are the same as assumed in the current project definition
		(3) The current project design satisfies the capacity and operational objectives established in the approved environmental document.

Item	Description	Item Detail
		(4) Mitigations committed to in the ROD (or project mitigation plans), when involving a physical or operational feature of the project, are incorporated - or in the process of being incorporated - into the engineering design, proposed construction program, and/or other implementation plans. Mitigations could include changes in design, use of different types of material, modified traffic control, restricted construction activities, etc.
		(5) Results of the hazard and threat and vulnerability analyses are incorporated in the design criteria and the scope of work.
4.2	Design Package	A Basis of Design Report is required which presents the following content: (1) Project Sponsor accepted design standards and performance objectives including consistency with the required transit capacity.
		(2) Design, construction, system and vehicle interfaces are well known and defined. Vehicle dynamic clearance and structure clearance diagrams are prepared.
		(3) Design Reports, Concept of Operations Report, and configuration studies are adequate and complete.
		(4) Design packages and contract packages are defined and delineated.
		(5) The documents possess a level of definition, clarity, presentation and cross-referencing consistent with the scope definitions in following sections.
		(6) The project is constructible. Adequate construction access and staging areas are identified.
4.3	Project Delivery Method Plan	Procedures for Procurement (advertising, bidding, awarding of contracts for consultants and construction contractors, procurement for equipment, etc.) are established including: Procurement Plan and Schedule (indicate project phase, durations for RFP, screening, interviews, selection, board approvals, etc.); Contracting Strategy for Transit-oriented and Joint Development; and identification of Disadvantaged Business Enterprises (DBE) Opportunities and Federal DBE and State/Local WBE & MBE Plans and Goals.
4.4	Constructability	Project Sponsor's construction planning of the project has sufficiently and adequately addressed the constructability of the project. An in-depth constructability review is required of the Project Sponsor. It is a critical tool for synthesizing the design work.
4.5	Site and Geotechnical Conditions	(1) Digitized aerial photogrammetry (aerial photo background; planimetric and topographic mapping) is complete.
		(2) Photo simulations and/or schematic renderings are available for stations, samples of the alignment, and unique features of the line.
		(3) Geotechnical investigations are complete including a subsurface exploration or laboratory testing program. Requirements for additional geotechnical investigations have been defined and identification of buried structures and utilities and identification of contaminated soils and other hazardous materials are complete.
4.6	SCC 10 Guideway	(1) Major or critical design decisions have been researched and decided including location and extent of elevated or underground structures, rehabilitation or reuse of any existing infrastructure, structures, facilities, or systems.
		(2) The choice of track or roadway design has been made for the line. Grade crossing construction is defined and clearances established for operations, maintenance, and emergency evacuation.

Item	Description	Item Detail
		Guideway drainage has been defined.
		(3) Major or critical work details, structural element dimensions, design interfaces, and physical interfaces have been identified and are defined in terms of drawings, standards, criteria, specifications.
		(4) Structural systems are established. Aerial guideway is dimensioned to show number of spans, span length, substructure design, etc.
		(5) Preliminary mass balance diagrams have been developed for vertical alignments on fill or cut supported by topographic surveys and soil investigations.
		(6) Retaining walls and fills are located and dimensioned and defined in terms of drawings, standards, criteria, specifications.
		(7) Tunnels, both cut-and-cover and mined, are defined in terms of access and egress, construction access and laydown, openings for stations, passage chambers, ventilation or emergency access shafts or adits, sections, and profiles to depict and dimension major tunnel features. Tunnel design and dimensions have been cross checked to adjacent building foundations and coordinated with the vehicle's dynamic envelope, walkways and egress, tunnel lighting, and systems elements such as ventilation, communications, and traction power.
		(8) Trackwork is advanced to a level where single line schematics of the track layout, plan and profile drawings, dimensioned layouts of turnouts and crossovers, and tabulations of track geometry (horizontal and vertical curve data) have been defined. The alignment of any tunnel structure is referenced to the center line of track and base of rail. Guideway sections, inclusive of aerial, tunnel and station cross sections, consistently show the distance from centerline of track to critical clearance points such as walls, walkways, and edges of platforms.
		(9) Special trackwork is located and adequately defined.
		(10) Where used, the contact rail system is specified with typical details and required clearances provided. End ramps and anchors are located. Gaps are coordinated with the traction power supply system. Feeder and return conductor attachment are specified and typical details provided.
		(11) The need for special track construction for noise or vibration control is identified with locations and dimensions and a preliminary choice is made for the noise and vibration control design.
4.7	SCC 20 Stations, Stops, and Terminals	(1) Major or critical design decisions have been researched and decided including rehabilitation or reuse of any existing structures, facilities or systems. Major or critical operational fire/life safety, and security requirements have been defined. Interfaces with other transit facilities or structures are identified and passenger and public circulation concepts defined.
		(2) Station architecture is established. The drawing package consists of site plans and, for station buildings, floor plans, elevations, longitudinal and cross sections, and details illustrating typical and special architectural conditions. The finish concept should be clearly described. The location and outline of fare gates and barriers should be shown. The location of ticket vending machines, electronic passenger information displays, security systems and other platform amenities should be shown.
		(3) Within the site context, the building footprints are shown. The relationship of the building to grade and to adjacent facilities is clearly defined, as is provision for pedestrians and bicycles to access the public way from the building. Provision for motorized vehicles is also shown. Access to the platforms and buildings and within the buildings complies with ADA. Any parking lots or structures are shown.

Item	Description	Item Detail
		(4) Building sections and elevations illustrate the relationship of the station to grade (below, on- grade, elevated structure); the building structural system has been chosen and preliminary dimensions established for clearances.
		(5) Station building floor plans show vertical circulation systems including stairs, elevators, escalators, and support spaces for mechanical, plumbing, electrical, and communications systems. The floor plans should show the agent area, fare gate area, retail areas, and any crew or public facilities.
		(6) Level boarding between the transit vehicle and the boarding platform complies with ADA. Documentation shows passenger level boarding design for all stations and/or satisfactory determination of infeasibility for one or more stations along with a satisfactory alternative plan for accessibility.
		(7) Preliminary identification of arts-in-transit integrated into station design.
		(8) Electrical systems should include a single line drawing including the source and distribution of power. Mechanical and electrical systems, including area drainage, piped utilities, heating ventilation and air conditioning, smoke evacuation, power, and lighting, are described and single line drawings are provided.
		(9) Design interfaces among disciplines are defined on drawings, in standards, design criteria, specifications and contract package scopes.
		(10) Parking structure design is progressed to a level consistent with station buildings as described above including vertical transportation and interface with the station buildings. Parking design is consistent with Record of Decision.
4.8	SCC 30 Support Facilities: Yards, Shops, Administration Buildings	(1) Major or critical design decisions have been researched and decided including rehabilitation, reuse or expansion of any existing structures, facilities or systems. Major or critical operational fire/life safety, and security requirements have been defined.
		(2) An architectural space program has been prepared for all occupied buildings including for modifications to existing buildings such as Control Centers. The support facility drawings are consistent with the architectural program. Adequate employee parking is provided.
		(3) Based on the vehicles chosen and utilization as set out in the fleet management plans, a review has been done to determine the number of vehicle spots and facilities (jacks, wheel truing, etc.) required.
		(4) A preliminary industrial engineering evaluation has been prepared for all workspaces in shops showing clearances, location of utilities (water, electric outlets, hose reels, etc.), and the flow of vehicles from revenue service through servicing and into storage or maintenance and then returning to service. Adequate space should be provided for material storage both in the building and outside.
		(5) A site plan has been prepared showing vehicle (revenue, non-revenue, commercial and private) access to shop buildings, storage yard layout, track layout, and location of auxiliary buildings including pump houses, signal houses, and traction power substations. Provisions for fueling and fuel storage are located. The overall site plan (existing and proposed conditions) should include grading and drainage plans, site cross sections, utilities, and roadway and parking plans.
		(6) Within the site context, the building footprints are shown. The relationship of the building to grade and to adjacent facilities is clearly defined, as is provision for vehicular and pedestrian access to new buildings. Access to the buildings and within the buildings complies with ADA.
		(7) Basic facility architecture is established including vertical circulation requirements. The drawing package

Item	Description	Item Detail
		consists of site plans and for buildings floor plans, elevations, longitudinal and cross sections, and details illustrating typical and special architectural conditions.
		(8) Building sections and elevations illustrate the relationship of the buildings to grade (below, on-grade, elevated structure); the building structural system has been chosen and is dimensioned for clearances.
		(9) Electrical systems should include a single line drawing including the source and distribution of power. Mechanical and electrical systems, including area drainage, piped utilities, heating ventilation and air conditioning, smoke evacuation, power, lighting, and fuel storage and dispensing are described and single line drawings are provided.
		(10) Design interfaces among disciplines are defined on drawings, in standards, design criteria, specifications and contract package scopes.
4.9	SCC 40 Sitework and Special Condition	(1) Major drainage facilities, flood control, housing types, street crossings, traffic control, utilities, are defined and physical limits and interfaces identified, based upon alignment base mapping, plans, and profiles.
		(2) Major or critical design decisions are defined including rehabilitation or reuse of existing structures or facilities.
		(3) Areas requiring clearing or demolition are identified.
		(4) Utility key maps, lists of owners, symbols and notes are provided. Preliminary utility relocation plans have been developed.
		(5) Mitigation plans are progressed for environmental issues and have accepted by the authority having jurisdiction. Mitigation facilities such as wetlands, buffers, noise barriers and historic preservation requirements are identified and located.
		(6) A survey for hazardous materials has been completed.
		(7) On-site and off-site mitigation plan requirements are identified and outline plans prepared.
		(8) Structural elements for retaining walls and other site structures are advanced in design.
		(9) Preliminary mass balance diagrams for vertical alignments on fill or cut are supported by topographic surveys and soil investigations.
		(10) Roadway modifications necessary to accommodate stations, guideway, or support facilities are defined and design is complete to a level comparable to that specified for guideway and stations. Traffic control devises or modifications have been defined.
		(11) The landscaping requirements, including irrigation systems, are defined on the station, support facility, and guideway plans.
		(12) The presence of buried structures, utilities, and contaminated soils which may have to be removed, backfilled or which would otherwise be unavailable for backfilling, has been taken into account.
		(13) Within the site context, the building footprints are shown. The relationship of the buildings to grade and to adjacent facilities is clearly defined, as are provisions for pedestrians and bicycles and special maintenance access. Provision for motorized vehicle access is shown. Adequate surface parking including spaces for disabled parking and facilities for bicycles is provided, where needed. Access to stations and buildings complies with ADA.
		(14) Adequate construction access has been considered; access and staging areas are identified.
		(15) Maintenance of traffic and railroad protective flagging are identified and costs estimated.
4.10	SCC 50 Systems	(1) Major or critical design decisions have been researched and decided including connections to, and rehabilitation

Item	Description	Item Detail
		or reuse of, existing systems. Pre-construction site reconnaissance and soil resistivity surveys are complete.
		(2) Major or critical work details, structural element dimensions, design interfaces and physical interfaces have been identified and are defined in terms of drawings, standards, criteria, specifications and contract package scopes. Single line or functional block drawings are prepared for each system. Technologies have been chosen, evaluated for cost effectiveness, and expected performance defined. Major equipment (for the control room, substations, grade crossings, tunnel ventilation, and traction power) has been defined and identified in terms of basic specifications, outline drawings, general arrangements, and standard drawings and details.
		(3) Signaling and Train Control – Decisions have been made regarding those sections of alignment to be operated under visual or traffic signal control as opposed to train signal systems. Operations analysis has determined the most efficient location of interlockings based on track layout, headways, train lengths, and braking tables as well as requirements of each interlocking and its control limits. Site specific requirements are defined (for signal structural work) and locations for signal enclosures and relay rooms including sizes as well as room layouts (relay, termination, power) are identified and defined. Signal cable routing methodology as well as power supply and distribution are identified and defined. Software and interface requirements (to facilities, existing system, and other system elements) are identified and defined. The scope of construction between contractors and other operators (railroads or existing agency systems) is defined. Maintenance, testing and training requirements are identified and initially defined (factory acceptance, site acceptance, field integration, start up, etc.).
		(4) Traffic signals - Basic coordination between train control and traffic signals or other traffic controls has been evaluated. The interaction among traffic signals in the immediate area has been coordinated with local jurisdictions. Simulations have been completed on the impact of the transit system on local traffic and the impact of signalization on transit running times. Decisions have been made regarding transit vehicle pre-emption or priority and interaction with emergency vehicle priority systems such as Opticon. Site specific requirements are defined (for structural work) and locations defined for crossing gates and signal enclosures. Related requirements for grade crossing protection, including use of four-quadrant gates or other methods to prevent vehicles from circumventing crossing gates have been identified and defined. The location of vehicle sensing elements is shown on intersection drawings. Software and interface requirements (to the train control system and other system elements) are identified and initially defined. The scope of construction between contractors and others is defined. Maintenance, testing and training requirements are identified and initially defined (factory acceptance, site acceptance, field integration, start up, etc.).
		(5) Traction Power – Traction power requirements and the location of substations is established. The basis of design including nominal project voltage and voltage limits are identified. The OCS system or contact rail layout is defined including conductor sizes relative to existing parts of system, as well as any supplementary parallel feeders to meet design requirements for substation out of service scenarios. Minimizations of voltage drop, maximization of vehicle propulsion system performance, and train regeneration issues have been initially addressed. Substation equipment requirements are identified. Single line drawings are provided. Preliminary equipment performance specifications have been developed. The source of commercial power is identified and preliminary negotiations have begun and technical interface conditions established. Substation grounding, stray current monitoring or testing, lightning arresters, and protective systems for equipment and utility system faults have been identified. Supervisory control has been defined as well as requirements for integration with central control.

Item	Description	Item Detail
		(6) Overhead Contact Systems (OCS) – OCS system type is identified and issues associated with temperature variations are addressed. Decisions have been made regarding the types of support structures or poles to be used, particularly in urban area. Tensions for the contact wire and messenger wire are defined; maximum distances between tensioning points are identified. OCS is sectionalized in coordination with the traction power supply. The basis for OCS design is established and design issues associated with overlaps, section insulators, and crossing and crossover locations are preliminarily addressed.
		(7) Communication System – Communications plans, including building or equipment locations, and provisions for station message signs, public address, emergency phones, security cameras, intrusion detection, and other system elements are defined and coordinated with station, guideway, support facility, and central control building plans. Cabling schemes are coordinated with the guideway and utilities. Preliminary specifications for the radio system have been developed and the system is coordinated with the vehicles and central control. Communication between field locations and central control is defined and coordinated with other systems.
		(8) Fare Collection System – The fare collection concept is defined and is accepted by all stakeholders. The number and location of fare collection equipment has been determined and is shown on the drawings. Basic equipment is specified.
		(9) Central Control – Operations control center plan is provided, including basic layout and space allocation requirements. System interface requirements and modifications for existing central control facilities are coordinated with the systems being controlled. Provisions for security and emergency response are considered. Preliminary equipment and control system requirements are established.
4.11	SCC 60 ROW, Land and existing	(1) The Real Estate Acquisition and Management Plan (RAMP) is complete. Refer to the OP-23 RAMP for more information. Real estate documents and drawings identify the full takes, partial takes, temporary and permanent easements, and other rights. Any special access requirements for existing structures have been identified. Possible eminent domain actions need to be identified.
		(2) Site surveys include property lines and identify structures for buildings, site features, utilities; and surface improvements such as streets and railroad rights-of-way, including private crossings of railroad rights-of-way.
		(3) The real estate information and survey information is fully coordinated with drawings of structures for guideways and buildings; site features; utilities; streets, railroads, transitways; construction easements; and site access and staging areas.
		(4) Parties to be relocated are identified and an action plan is developed.
		(5) Hazardous material sites are identified and characterized and the responsibility and scope of remedial actions specified.
4.12	SCC 70 Vehicles	(1) Refer to OP-38 for additional information.
		(2) Vehicle performance requirements are specified and incorporated into the Design Criteria, the Operations and Maintenance Plan, and the Bus or Rail Fleet Management Plans. Preliminary specifications must include allowable vehicle static and dynamic clearance diagrams, allowable axle weight, allowable total weight, door location, floor height, passenger capacity (seated and under heavy load conditions), and ADA accommodation. For buses, the specification must also include fuel type and turning radius. For rail, the specification must include acceleration and deceleration characteristics and expected train consist.
		(3) System Interface Functional Descriptions have been developed and advanced to include the following: definition of the subsystems that constitute the overall vehicle system; description and graphic depiction of

Item	Description	Item Detail
		each interface between on-board subsystems and wayside systems; and, description of how each subsystem will meet the project requirements.
		(4) Expected vehicle servicing, periodic maintenance, and component repair and replacement requirements (estimated time to repair and frequency of repair) should be compiled to support shop design (SCC 30)
		(5) Testing requirements have been developed to include the following: high level Test Program Plan for both production and on-site acceptance including requirements for factory inspection and testing, First Article and Pre-shipment inspections, static and dynamic testing, and conditional acceptance.
		(6) Maintenance and Training Requirements should be defined and identified including development of maintenance and training requirements for new system elements.
		(7) Requirements for special tools and equipment have been established as well as requirements for initial spare parts orders.
4.13	SCC 80 Professional services	(1) The roles and responsibilities of Project Sponsor's professional consultants (design, engineering, and construction management) may be distinguished from Project Sponsor's own professional staff. If alternative delivery systems (design-build, CM/GC) are proposed, the costs of design professionals employed by the contractor should be identified.
		(2) Costs associated with construction – building contractors' management, labor, indirect costs, overhead, profit, construction insurance should not be included in SCC 80 but in SCC 10 through 50 as appropriate. Cost estimates should conform to this allocation of cost.
		(3) When Project Sponsor's manual labor, equipment and facilities are used to facilitate construction or to assist in construction of the project, a Force Account Plan and cost estimate should be provided. The cost of these services should be applied to the appropriate SCC code with the exception of start-up training.
		(4) Costs associated with permits, insurance, and taxes are researched, identified, and estimated.
		(5) Costs associated with start-up training and simulated operation for operators and supervision is estimated.
5.0	**SCHEDULE**	
5.1	Basis of Schedule	(1) Includes a logical document that discreetly defines the basis for the development of the project schedule that identifies key elements, issues and special considerations (assumptions, exclusions, etc.)
		(2) Describes the planning basis, including resource planning methodology, activity identification, duration estimating, and source and methodology for determining logic and sequencing.
		(3) Identifies labor productivity adjustments, including congestion assessment, extended work hours, winter work, curfews, etc.
		(4) Documents all production rates, identifies basis for startup and sequencing requirements, and defines any owner requirements (regulatory, environmental, Quality/ inspection)
		(5) Is consistent in use of the time sensitive variables in the capital cost estimate, including year of expenditure assumptions, and durations incorporated into the master schedule.
5.2	Schedule Format	Is consistent with relevant, identifiable industry or engineering practices. Software is appropriate for the size and complexity of the project.
5.3	Schedule structure	(1) Work Breakdown Structure has been applied in the development of the schedule.
		(2) WBS consistent with the analyzed plan and program for all project participants' agreed upon roles, responsibilities, capabilities and capacities.
		(3) The project schedule is in original and SCC format.

Item	Description	Item Detail
5.4	Schedule level	The schedule shall be sufficiently developed in detail to determine the validity of the project critical path to revenue operations. It should break out, at a minimum, project milestones, FFGA/SSGA related work, planning and environmental, public involvement, Project Development, value engineering, final design, right-of-way, permits, third party agreements, public and private utility relocations, safety and security, construction, trackwork, train control systems, vehicles, system integration, communications, fare collection, and startup and testing in sufficient detail to confirm the reasonableness of durations and sequencing and to estimate the probability of schedule risk
5.5	Schedule elements	(1) Schedule reflects the project scope that is described in the approved environmental document.
		(2) Schedule includes adequate time and appropriate sequencing for:
		• Reviews ▪ Required FTA-related environmental, risk assessment, PMP reviews, readiness reviews at designated milestones, and grant approvals ▪ Project reviews by applicable local, state and federal jurisdictions and affected third parties • Agreements ▪ Right-of-way acquisition; household/business relocations ▪ Utilities relocation ▪ Railroad purchase and/or usage ▪ Interagency Agreements ▪ Funding time frames and/or milestones for FTA and non-FTA sources ▪ Procurement and manufacturing durations for equipment and vehicles, especially for Long Lead Items, are adequate and complete ▪ Procurement of design contracts for civil/facilities, systems, and vehicles ▪ Performance of design contracts to produce 100 percent complete documents prior to bidding ▪ Bid and award periods reflect the required sequencing and durations for the selected project delivery method and logically tied to the proper work activities ▪ Construction processes and durations are adequate and complete, and allow schedule contingency for potential delays, including inter-agency work, utility relocation, civil, architectural, and systems work, Project Sponsor operations and maintenance, mobilization, and integrated pre-revenue testing.
5.6	Resource scheduling	(1) Quantities and costs as defined in the cost estimate match the resources/costs assigned to the activities in the schedule.
		(2) The distribution of resources and costs per specification or industry standards are reasonably associated to the activity it is assigned.
5.7	Schedule control	Define the approach to and use of scheduling tools, such as scheduling software, Project Sponsor procedures for schedule change and update, use of a work breakdown structure, assignment of staff responsibility for schedule, cost loading, resource loading, etc.
6.0	**CAPITAL COST ESTIMATE**	
6.1	Basis of Estimate	(1) The Project Sponsor needs to provide a Basis of Estimate report describing its cost estimating approach. The report should be developed by the Project Sponsor as part of its initial Project Development work and updated with each subsequent estimating effort.
		(2) The Basis of Estimate outline should be as follows:

Item	Description	Item Detail
		• Estimating Methodology – Describe the general approach to defining and quantifying the project capital cost estimate. • Sources of Cost Data – Define the nature and sources for cost data used in the preparation of the estimate; ▪ Cost Estimating Assumptions
		▪ Allocated Contingency ▪ Unallocated Contingency ▪ Escalation ▪ Contract packages • Estimating Procedures – If multiple parties are estimating parts of the project, this memo should help to ensure consistency of approach. • Organization and Management of Cost Data (by segment elements; project-wide elements) • Bottom Up and Top Down Approaches (e.g. at Entry to Project Development, it could be reasonable to use Bottom Up estimating approach for Guideway, Stations, Support Facilities; and Top Down estimating approach for Sitework, Systems, ROW Land Existing Improvements, and Vehicles) • Facilities (Guideway, Stations, Support Facilities) Costing Procedures for typical construction methods and for construction and components unique to transit projects. • Estimate Limitations – Describe perceived or known uncertainties, as well as unknowns that could lead to changes in the estimate due to changes in project scope and design standards, incorrect unit cost or quantity assumptions, and unforeseen problems in implementation. • Tracking Costs – Describe how capital costs in the SCC format will be tracked through construction, revenue operations, etc. (e.g. provision in Division 1 requiring contractor to submit SCC update with monthly pay application). FTA requires that costs be tracked in the SCC format through construction, revenue operations and through two years post- revenue operations to document contract closeout and the "after" point for the Before and After Study. (Note that the Before and After Study may not be required for Small Starts projects.)
6.2	Value Engineering (VE) report	(1) VE effort has been performed on the design completed in Project Development and a report has been prepared. Focus should be on VE recommendations approved by the Project Sponsor and incorporated into the project. The Project Sponsor should identify why recommendations were or were not approved.
		(2) The cost estimate should incorporate the accepted changes.
6.3	Standard Cost Categories (SCC) Workbook	(1) Work Breakdown Structure formatted to conform to the FTA SCC.
		(2) Workbook includes SCC annualized worksheets.
		(3) Estimate is in general agreement with the latest SCC information contained in the Project Sponsor's most recent New Starts submission.
6.4	Capital cost estimate	(1) SCC category 10-50: Fixed Construction (guideways, stations, support facilities, sitework, systems) • Construction Materials ▪ Quantities have been calculated with appropriate conservatism to accommodate development to a more advanced stage of design if appropriate
		• Allowances for material quantities have been included for commodities which cannot be fully quantified at the present level of design • Unit Prices have been developed using the best available local market information;

Item	Description	Item Detail
		• Project sales tax exemption status has been established if appropriate and incorporated in materials costs • Quotes have been obtained for specialty and price-sensitive materials • Materials costs reflect market volatility • Construction labor ▪ Local wage rates, fringe benefits, and work rules are incorporated ▪ Local payroll taxes and insurance rates are incorporated ▪ Holiday / show-up / vacation pay is incorporated ▪ Crew productivity is appropriate and conservative for the task under evaluation ▪ Availability and variability of utility and railroad outages and "track time" have been incorporated in a conservative manner in determining the crew productivities for impacted work • Construction equipment ▪ Local equipment rental rates and current fuel costs are incorporated ▪ Quotes have been obtained for specialty equipment. • Escalation for Construction Materials, Labor and Equipment ▪ Confirm that adequate escalation rates have been applied to estimates of material, labor and equipment costs. Costs to anticipate prices at the time of project bid. • Special considerations ▪ Utility and Railroad labor, equipment, and overhead rates have been verified and incorporated in third party or "force account" work pricing, as well as local utility/RR work and safety rules ▪ Special consideration has been given to support operations and facilities for tunneling operations, facilities to support operations in contaminated/hazardous materials, etc. • Construction Indirect Costs, Multipliers for Risk etc. ▪ Contractor indirect and overhead costs are advanced beyond a percent of the associated construction direct costs and should be analyzed based on field and home office indirect costs such as contract duration, appropriate levels of staffing (including project managers, engineers, safety engineers, schedulers, superintendents, QA/QC engineers, craft general foreman, labor stewards / nonproductive labor, warehousing, project trucking, survey layout, purchasing, timekeeping, etc.), mobilization / demobilization costs, equipment standby / idle time costs, reviewer office / lab / tool facilities, safety equipment, QA/QC testing equipment, temporary utilities (sanitary / power / light / heat), jobsite and public security measures, etc. ▪ Appropriate costs have been included for payment and performance bonds and special insurance requirements (RR protective, pollution liability, etc.). • Other construction insurance costs and/or project-wide coverage (Owner Controlled Insurance Policy) has been included based on quotes from appropriate carriers. ▪ Contractor profit / risk costs have been incorporated that reflect the proposed delivery method and expected level of competition by contract package (higher profit margin where few competitors will bid).
		(2) Cat. 60 - Real Estate • Includes estimated costs (acquisition costs) for the real estate and associated relocation costs. Costs for professional services, both contracted and in-house legal, appraisal, review appraisal, settlement costs, environmental site assessments, demolition, real estate and relocation consultants have been included (and not included in SCC 80). Easements, acquisitions, inspections, takings, etc. have been appraised or estimated by qualified professionals familiar with local real estate markets and practices, especially

Item	Description	Item Detail
		any acquisitions involving freight railroads. Includes allowance for the expected increase in costs over appraised value. Includes costs for taxes attributable to real estate acquisition.
		(3) Cat. 70 - Vehicles Estimates account for current purchase prices for similar vehicles or quoted prices from manufacturers. Includes costs for professional services (both contracted and in-house) for vehicle design and procurement, and not included in SCC 80. Estimates allow costs for special tools and equipment and spare parts. Requirements for non-revenue support vehicles identified and include in estimate.
		(4) Cat. 80 - Professional Services • Costs included for both contracted and in-house, for all professional, technical and management services related to the design and construction of fixed infrastructure (Cats. 10 - 50) during the Project Development, engineering, and construction phases of the project. This includes environmental work, surveying, geotechnical investigations, design, engineering and architectural services; materials and soils testing during construction; specialty services such as safety or security analyses; value engineering, risk assessment, cost estimating, scheduling, Before and After studies, ridership modeling and analyses, auditing, legal services, administration and management, etc. by agency staff or outside consultants. • Professional liability insurance and other non-construction insurance should be included on 80.05. • Confirmation that cost estimates are based on realistic levels of staffing for the duration of the project through close-out of construction contracts. (The estimate should be consistent with the Project Management Plan.) • Confirmation that costs for permitting, agency review fees, legal fees, etc. have been included. • General Conditions included for design, construction, and procurement contracts. • If alternative delivery systems (design-build, CM/GC) are proposed, the costs of design professionals employed by the contractor should be identified.professionals employed by the contractor should be identified.
6.5	Contingency	Allocated Contingency – Confirmation that adequate contingency has been allocated to each of the SCC categories based on the perceived risk inherent to each category's estimate.
		Cat. 90 - Unallocated Contingency - Confirmation that adequate contingency has been added to the total project cost based on the perceived project risk.
		Total Contingency should be consistent with that derived in the Risk and Contingency Management Plan.
6.6	Cat. 100 – Finance Charges	Finance charges included, consistent with FTA's Financial Management Oversight Consultant's review.
6.7	Inflation	Confirmation that adequate inflation rates have been applied to Base Year project costs to anticipate costs at procurement or bid; the Year of Expenditure costs should be developed thoughtfully. Reference indices should include ENR Building Cost Index and Construction Cost Index or other demonstrated authoritative source.
7.0	**RISK AND CONTINGENCY MANAGEMENT**	
7.1	Risk process established	(1) Risk organization is in place, with independent reporting to executive management and roles and responsibilities defined.
		(2) Contingency management, contingency use authority, and reporting structure is established.
7.2	Risk identification	(1) Risk register is developed, with risk categories and priorities. (2) Process is established to update risk register.

Item	Description	Item Detail
7.3	Risk assessment	(1) Valuation of project cost risk by method appropriate for project
		(2) Valuation of project schedule risk by appropriate methods
		(3) Documented report demonstrating valuation method and result
7.4	Risk Mitigation	(1) Mitigation process in-place with documented responsibilities.
		(2) Established insurance plan
		(3) Contingency amounts identified and tied to risk assessment
		(4) Requirements risks clearly identified and resolved; plans in place for unresolved requirements risks
		(5) Secondary mitigation plan defined and documented
7.5	Risk management	(1) Plans for amendment of the risk register during the course of the work, to both succinctly catalogue additional significant issues that arise, as well as to identify closure of issues as they become resolved to the satisfaction of the Project Sponsor and the FTA.
		(2) Plans and timing for systematically updating the RCMP.
8.0	**CERTIFICATIONS, REPORTS, AND ADMINISTRATIVE REQUIREMENTS**	
8.1	**Administrative requirements**	
8.1.1	Legal Authority to implement transit mode project	The Project Sponsor must perform a review of existing statutes to gain a full understanding of the Project Sponsor's authority and any legal constraints that may affect the project. The purpose should be to identify requirements and constraints in an orderly and timely manner and to deal with them as the project advances. Failure to recognize and accommodate legal requirements may jeopardize the entire project and, at the very least, severely impact the subsequent grant approval process and project schedule, as well as project costs. The project sponsor must be diligent in maintaining cognizance of changes in the legislative/regulatory environment which may impose future constraints on a project. This legal authority must be reviewed to confirm that it addresses all forms of project delivery that may be considered.
8.1.2	Legal Authority to use alternative project delivery method	Provide evidence of authority under non-Design-Bid-Build format.

APPENDIX E – A PROJECT SPONSOR'S GUIDE TO FTA NEW STARTS PROJECT RISK REVIEW

Introduction

FTA's risk review of major capital projects has evolved over the years from a stand-alone "bottom-up" risk analysis of technical risk, such as geotechnical risk, to an integrated "top-down" risk analysis of technical risk and the management capacity to mitigate that risk within the constraints of the project budget and schedule. The FTA recognizes that many projects may use either style of risk analysis, and in the hands of seasoned risk professionals, either style may produce valid, informative results. When producing its own risk analysis, however, the FTA utilizes the "top-down" method. This process has contributed to improvements in project management not only in terms of the tracking of risk, associated mitigation efforts, and available contingencies, but also in reporting on the Project Sponsor's risk response and effective contingency management.

FTA undertakes this review either with its own staff or in conjunction with its Project Management Oversight Contractor (PMOC), but for purposes of this narrative the reference is only to FTA. This is a data driven analysis based on both FTA and Project Sponsor experience. First, FTA relies in large part upon its ongoing reviews of Project Sponsor-supplied project documentation required by the Project Management Plan and its sub plans. (See Figure 1 for the key components that go into the Risk review process.) Next, industry experience in the form of Transportation Research Board (TRB) and other internal studies is also integrated into this effort. Finally, FTA relies on extensive analysis from past and on-going major capital projects, including work done by the PMOC community, that yields lessons learned on managing technical risks as well as on project management capacity and capability to provide best practices, suggested mitigation measures, and suggestions for risk-informed and optimized decision making.

As stated above, this FTA review relies on and builds off of the Project Sponsor's management plans and cost and schedule data, and, if available, the Project Sponsor's own risk assessment. FTA has always encouraged Project Sponsors to develop their own risk assessments for use in managing the project cost and schedule, and as the basis for an informed discussion between FTA and the project team. The role that a Project Sponsor's risk assessment plays in informing the FTA risk review depends upon the quality of its assessment. FTA will review the Project Sponsor's information, using the criteria below, and determine if and to what extent it will be integrated into the FTA assessment. If the information is not adequate, FTA will develop any additional data needed to complete its risk review.

FTA will use the following criteria in reviewing the Project Sponsor's information: Is it sufficient to allow the Project Sponsor to meet FTA's requirements? Is it capable of providing grounds for independent analysis and reproduction? Is it relatively free of inherent bias? And, is it adequate for an FTA assessment of its adequacy, accuracy or completeness?

When a risk assessment is done correctly, FTA and the Project Sponsor are made aware of the technical risks and requirements for management capacity facing a particular project; understand the potential impacts to the project's cost and schedule for each risk identified; and are able to develop strategic plans for rapid intervention and effective mitigation should a risk begin to materialize. Failure to do this can be catastrophic to a project.

FTA conducts risk reviews at critical points during a project's lifecycle. Experience teaches that risk reviews are especially important during the earlier phases of projects because opportunities to avoid or at the least mitigate risk diminish substantially as projects move beyond planning into design and construction. In the New Starts program, risk reviews benefit project planning and management in an evolving fashion as a project transitions from Project Development, to Engineering, to a Capital Investment Grant (CIG) (such as an FFGA or SSGA), through construction and into start-up. The Project Sponsor is encouraged to also include risk assessments during the Project Development phase as well. Early in a project, the benefits are likely to include identification of missing scope and/or weak or uncoordinated cost estimates, enhancing design management and pre-construction planning, and prioritizing project risks so that mitigating efforts can be taken. By the time a project nears completion of final design, and most of the contracts are through the bidding process, the risk review primarily focuses on mitigating construction risks, sizing the required contingencies, and defining or verifying the process for using contingencies.

FTA works closely with the Project Sponsor during the FTA risk review in order to facilitate the process, encourages the Project Sponsor's buy-in to the assessment and its outcome, and provides the Project Sponsor with the background necessary to incorporate risk review recommendations into its Project Management Plan (PMP) and Risk and Contingency Management Plan (RCMP). While FTA, in conducting risk reviews, is interested in a number of factors, such as determining what level of oversight a project needs and whether a New Starts project is ready to advance to the next phase, it must be emphasized that at all times, for all purposes, the Project Sponsor retains full responsibility for managing all project risk. It is imperative that a Project Sponsor understands FTA's objectives and process, makes its information available, participates in good faith during the risk review process, incorporates FTA's risk review recommendations into the PMP and RCMP in a meaningful way, and takes ownership of those documents as primary tools to mitigate risk throughout the life of the project. These reviews are intended to occur concurrently with the Project Sponsor's project development process.

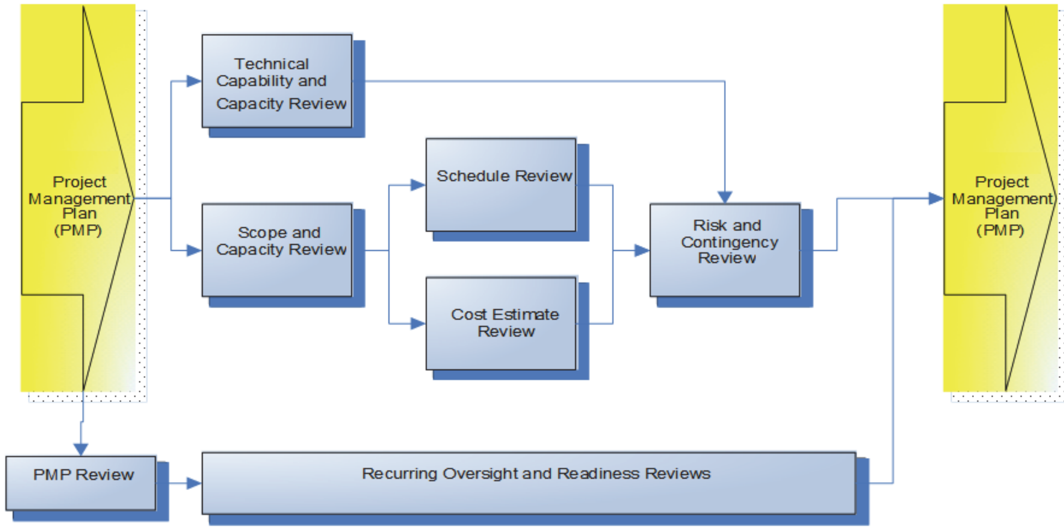

Figure D-1: FTA's Risk-Informed Project Management Oversight

The Risk Management Process

There are many technical sources available that discuss the procedure and specifics on risk management. This section is not meant to convey technical detail to the reader. It is only meant to present a framework for evaluating project risk that is common to a large variety of analytical models, but at the same time meets FTA's requirements for determining the reliability of the Project Sponsor's cost and schedule.

Establishing the Project Basis

The basic goals of a risk management process are to: (1) identify and quantify uncertainties and their potential impacts on the Project Sponsor's ability to achieve project objectives within defined scope, cost and schedule constraints, and (2) develop explicit plans and tools for mitigating risk, developing management capability and capacity to control risk, and managing current and future contingencies. The necessary first step in the risk management process is to scrutinize the status and soundness of the project's definition of basic – and known – project elements (e.g., overarching project development requirements, scope, design criteria, quality assurance, contract packaging and methods of delivery, cost estimates, and schedules) which serve as the starting points for identifying risks and opportunities. Thus, it is crucial that these known project elements be validated and, if necessary, corrected before attempting to address a project's uncertain elements. A 2005 internal FTA study on risk management performance concluded that only 50% of the cost overruns in selected projects were related to risk factors, the rest was due to systematic underestimation, including the failure to adequately assess risks, failure to identify and confront foreseeable adverse conditions, and the full range of project cost components. Therefore, if key project components are missing or itemized costs are seriously understated, it is not possible to accurately ascertain the risk basis from which costs are expected to vary and the Project Sponsor may not know how to develop the correct risk avoidance measures.

In advance of performing a risk review, FTA must first fully understand the Project Sponsor's basic assumptions in advancing the definition of the project, which is best done through a review of documents that describe project goals and third-party requirements; site evaluations; project plans, estimates and schedules; progress reports; project management documents; and other necessary supporting documents.

If the documents that define the project have insufficient detail or there are inconsistencies or mismatches between design documents such as reports or drawings and schedules, cost estimates or work breakdown structures, such that the drawings are significantly more current than the cost estimate, then the validity and usefulness of a risk review based on such documents would be compromised. It is also especially important that cost estimates be properly categorized into FTA's Standard Cost Categories (SCCs).

In order to avoid double counting, since contingencies are a legitimate way to account for risk, as part of the review FTA will work with the Project Sponsor to ensure that its estimates and schedules clearly identify and quantify contingency amounts. This includes cost and schedule contingencies that are applied or allocated to individual line items or activities (some of which may be "hidden"), as well as unallocated contingencies that are often derived as percentages of grouped items.

Identifying the Risks

Simply put, before risks can be managed, they must be identified. As a management process, risk identification "surfaces" risks before they can become problems and impact or adversely affect a project. FTA's definition of risk identification includes examining the elements of project definition and project processes to "surface" the associated uncertainties and their root causes that may prevent the project from being delivered within the constraints of intended scope, schedule and cost given the Project Sponsor's management capability and capacity. This is the crux of successful risk review. As a process though, it is not enough to just identify risks, the assessment must also deliver value throughout project implementation. To achieve that goal, risk identification must facilitate management planning for the Project Sponsor organization through analysis which allows the conversion of "surfaced" risk data into risk decision-making information that provides the basis for the Project Sponsor to prioritize and address project risks.

As a result, FTA's risk review uses a risk mitigation sequence, the key principle of which is that the ability to mitigate technical risk declines as the project advances from requirements definition through design solution into project delivery method, while management capacity to mitigate that risk within defined constraints builds up in a maturity sequence as the Project Sponsor develops management strategies that move from simply implementing best practices to developing specific mitigation capacities, through documenting risk-informed decision making for Project Sponsor management, to institutionalizing changes in governance and internal controls.

Thus FTA's risk review process focuses not just on risk identification but also identifying specific management changes the Project Sponsor can implement to manage the risk at various stages of the project. To accomplish this objective, metrics must be developed by the Project Sponsor for project activities that can be readily and timely reported (and validated) so as to provide management with a performance-based and continuous assessment of costs and schedule impacts on the achievement of project budget and revenue service date goals.

Consistent with the concepts expressed above, to maximize the effectiveness of the risk review process and results, Project Sponsors must instill in their staff a sense of the importance of the process and provide sufficient staff resources, along with a defined process and outside expertise as necessary, to develop a thorough inventory or listing of all reasonably conceivable risks facing the project. This listing, often referred to as a risk register, provides the basis for tracking the status of previously identified risks, adding new risks as they become identified, developing risk mitigation measures, assigning responsible parties to attend to the risks, and monitoring risk-specific action items.

FTA will review the Project Sponsor's risk register and supplement it with any additional risks FTA may have independently discovered through FTA's review of project status, scope, cost estimate, schedule, and contract packaging, as well as an analysis of the Project Sponsor's project management capacity and capabilities. The risk register is then further refined through joint discussions with the Project Sponsor.

Risk Treatment

Risk treatment is a process that identifies, evaluates, selects, and implements options in order to set risk at acceptable levels given project constraints and objectives. This includes the specifics on what should be done, when it should be accomplished, who is responsible, and the associated cost. The handling options available can include risk control, risk avoidance, risk assumption, and risk transfer. The most appropriate treatment is selected from these handling options.

At each stage of the project, the Project Sponsor should implement decision processes that document how it established and allocated risk and then, as appropriate, whether it transferred some risk to contractors it hired to perform discreet tasks. It is rare, however, that all project risk can or even should be transferred to contractors, and FTA through its oversight process will review how much risk Project Sponsors have assigned to other parties in order to determine the Project Sponsor's effectiveness and efficiency at transferring such risk and whether the Project Sponsor has overstated the amount of risk that has been successfully transferred as contracts are let. A Project Sponsor should constantly review the project's risk register as contract packages are developed so that opportunities for risk transfer are identified and incorporated into contract documents in a deliberate and appropriate manner. The risk register should be updated as contracts are awarded to identify those risks either partially or fully mitigated through risk transfer and those risks which remain with the Project Sponsor. FTA will periodically review major contracts and the risk register to make sure the Project Sponsor is appropriately transferring risk and understands what risks have and have not been transferred.

Assessing the Impact of Risks

Risk assessment is a process of determining and understanding the quantifiable effect(s) of risk on the project's cost and schedule. Inasmuch as the risk assessment process is invaluable to the successful mitigation of risks, FTA will verify the integrity of the Project Sponsor's risk assessment process and may perform an independent assessment of cost risk and schedule risk using the principles discussed above. Cost risk and schedule risk are usually interdependent with one another and consideration of one must necessarily include consideration of the other. However, as detailed below, there are some methodologies that are specific to the assessment of cost risk whereas schedule risk is more effectively assessed by other means.

Methodologies for Assessing Cost Risk and Schedule Risk

Assessing Cost Risk

Cost risk is fundamentally about potential cost overruns and the effects of cost overruns on the delivery of a project, as scoped and approved, within an established budget and schedule. This uncertainty concerning the potential for cost overruns arises first from the underlying technical uncertainty of achieving the project's objectives, or requirements risk, design risk, market risk, and construction risk; and then, second, uncertainty associated with the Project Sponsor's ability to demonstrate the management capacity and capability (MCC) to mitigate that technical risk within an acceptable range, or management risk.

FTA utilizes the following cost analyses to assess project-level cost risk:

- Stripped and adjusted cost estimates
- Standard cost category (SCC) ranges, as applicable
- SCC cost item risk curves, as applicable
- Analysis of project delivery method(s)
- Project-level risk

Stripped and Adjusted Cost Estimates

As a project's cost estimate is developed and refined, the Project Sponsor and its engineering/design/project management team includes contingency funds to compensate for the level of uncertainty in the estimate and allow for variance in inflation costs. A stripped cost estimate is the project's cost estimate completely devoid of all the contingency amounts that have accumulated during the project development process, and developing this requires close coordination between FTA and the Project Sponsor. Some contingency amounts are exposed and are readily identified whereas other contingency amounts are latent or hidden within the cost estimate.

The identification of all such contingencies, especially latent contingency funds (which are usually allocated to individual line items) requires close coordination with the Project Sponsor. Particular attention should also be paid during this process to contingent funds that may be embedded within estimates for inflation or escalation risk.

Once FTA and the Project Sponsor believe they have arrived at a stripped cost estimate, FTA develops an adjusted cost estimate based on an analysis of several factors, including cost analysis by SCC where applicable. An analysis of costs by SCC makes use of an analysis of the project's scope vis-à-vis the schedule, and FTA's database of SCC costs from previously completed major capital projects to determine if some SCC items might be understated or overstated. After these analyses and following careful discussions with the Project Sponsor, FTA makes adjustments to the stripped cost estimate and develops a project's cost, without any risk-based contingencies or inflation.

In conjunction with the analytical work on the project schedule, the adjusted cost estimate is inflated to the year of expenditure (YOE). This adjusted YOE cost estimate becomes the basis for the remainder of the cost risk assessment. The inflation rate used for developing the Adjusted Cost Estimate should be a rate that is stripped of contingency, in a manner similar to the stripping of contingencies from other estimate line items. This Adjusted Cost Estimate, appropriately stripped of contingencies, establishes an optimistic level of cost forecast for the various estimate line items.

Standard Cost Category (SCC) Ranges

FTA then establishes likely ranges of cost for the various SCC elements based on the stripped, adjusted YOE cost estimate that would be considered to be an optimistic best case, then forecasting what the worst-case (or pessimistic) outcome of the project may be using methods discussed below. The stripped, adjusted YOE cost estimate (as described above) for each SCC cost element is used to establish the SCC cost element range of costs.

The upper limit of the SCC cost element range can be established by applying specific historic risk experiences to various SCC line items. The upper range is calculated by multiplying the stripped, adjusted SCC value by a "range factor" which derives the upper limit of cost that the element has historically experienced. In the FTA method, these range factors are called "Beta Range Factors" (BRFs). BRFs are the sum of risk category factors for requirements risk, design risk, market risk, and construction risk plus an added base factor of 1.05. The 1.05 base factor provides for a 5 percent "end-of-project" risk allowance, which recognizes that some level of risk generally remains, even at the end of construction. FTA uses these risk range calculations to establish a baseline, and then adjusts the BRFs to reflect actual project conditions as reflected in the project's risk register. While this is a judgment call that is based on analysis of the project's documents and management plans, through the risk identification and assessment process FTA is able to identify whether and where the Project Sponsor is likely to face similar risks and whether or not the Project Sponsor has tools in place to address these risks. FTA discusses this risk range with the Project Sponsor so that there is a clear understanding of where and why FTA sees the risk occurring and whether the Project Sponsor has the management capacity to mitigate the risk.

SCC Cost Item Risk Curve

The FTA "top-down" risk assessment model, using BRFs, assumes that risk for a category follows a standard risk distribution function that was derived from historic FTA projects. While detailed description is beyond this Appendix, interested readers may find a discussion of these kinds of risk curves (or probability distribution functions) in standard texts and other references. Further, the National Transit Institute (NTI) provides a course (as of 2015) that describes this process in detail. Calculations using this information provide the ability to forecast potential project costs and to provide recommendations regarding sufficiency of project budgets and contingencies. These calculations are modeled in the FTA Cost Risk Assessment Workbook.

Consideration of Project Delivery Method

Project delivery methods, whether they are traditional (e.g. design-bid-build) or an alternate method (e.g., design-build, etc.) can affect the timing and scope of risk sharing, but not necessarily the magnitude of risk nor the sequence of risk mitigation. Traditional project delivery methods transfer or share much of the construction risk at the completion of design and procurement. Alternate project delivery methods may transfer or share some components of requirements risk, design risk, market risk and construction risk prior to the completion of design activities. Regardless of delivery method, if risk exists, it will affect the cost and schedule of the project – perhaps included within the cost of contracted work. The extent and effectiveness of risk transfer and risk sharing inherent in alternative project delivery methods are considered when developing recommendations for risk assignment.

Project Level Cost Risk

Project-level risk is an aggregate of the risks associated with all SCC Category Cost Ranges. Project-level risk is modeled by the PMOC/FTA, using the FTA Cost Risk Assessment Workbook.

FTA produces and shares a summary table and chart with the Project Sponsor that lists the Project Sponsor's estimated project costs and the adjusted YOE cost estimates along with its assessment data, including the variability determined in the risk assessment, and its effect on the overall budget. FTA also provides an analysis of the key risk drivers, in a narrative format, for those project elements with the potential for large cost risk impact.

Assessing Schedule Risk

Schedule risk is fundamentally about potential delay(s) to the project's critical path and subsequent effects to the delivery of a project within an established timeframe. Schedule delay may reduce schedule float, require use of schedule contingency or threaten the project completion date. FTA utilizes the following analyses in its evaluation of schedule risk:

- Stripped and Adjusted Schedule
- Summary Risk Schedule
- Summary Activity Risk
- Project Level Schedule Risk

Stripped Schedule and Adjusted Schedule

FTA analyzes the Project Sponsor's schedule and removes all risk-based contingency durations, leads/lags, constraints, etc., to develop what is called the stripped schedule. Such contingencies to be removed may include both unallocated (perhaps applied as a dummy activity at the end of the project or sub-network) and allocated (perhaps applied as increases to individual activity durations) contingencies. Both patent (exposed) contingency durations and latent (hidden) contingency durations shall be identified in close coordination with the Project Sponsor. This coordination is especially important in the case of schedules, due to the complicated nature of modern schedules and the effect of items such as logic ties that may reflect risk-based logic.

After discussion with the Project Sponsor, the FTA increases or decreases activity durations in order to produce an adjusted schedule. The adjustments may also be applied to the activities developed in the Summary Risk Schedule, as described below.

Summary Risk Schedule

FTA works with the Project Sponsor to develop a summary schedule that will be used for calculating project schedule risk; this facilitates the risk analysis process and helps to communicate the effect of project risk to the project team and others. The summary risk schedule is designed to be a logically-correct, critical-path method (CPM) schedule that adequately reflects the interrelationships among its activities so as to reproduce the effect of a variation in any activity upon the other activities. The number of activities modeled should be commensurate with adequate expression of risk and the level of detail available in the Project Sponsor's schedule at the time of analysis.

Summary Activity Risk

FTA will identify duration ranges for the activities of the Summary Risk Schedule through a process of evaluating the specific project attributes (especially including those noted in the Risk Register), in consultation with the Project Sponsor. The adjusted schedule durations described above will be used to establish optimistic duration estimates. Through the analysis of schedule-related items on the risk register, FTA will additionally establish the most likely, pessimistic estimates for activity durations.

Project Level Schedule Risk

Once the activity duration ranges are established, FTA will use this data to develop a range of project-level schedule outcomes. FTA may apply use of a commercially-available project scheduling software system that is capable of critical path scheduling and stochastic modeling for probabilistically-described activity durations (often referred to as "Monte-Carlo" simulations). This system is used for capturing and reporting activity risk duration ranges, as well as reporting the resulting project-level schedule risk assessment. This analysis will provide a histogram of potential schedule completion dates, along with the percentage likelihoods of those completion dates. FTA will compare these dates against targeted completion dates for the project and comment and provide recommendations from this comparison.

The schedule risk simulation provides the basis for evaluating the predicted range of completion dates as compared to the Project Sponsor's scheduled milestones. The simulation approach also provides statistical measures such as range, mean, minimum and maximums. In this analysis, FTA can identify critical and near-critical paths and the relationship between those paths and previously identified schedule risks.

Risk Mitigation

FTA will identify risk mitigation recommendations that the Project Sponsor may adopt to supplement its own mitigation efforts in its Risk and Contingency Management Plan. FTA has found it to be a very effective practice to categorize the risk mitigations by SCC, Risk Category, and Mitigation Type, and to organize the risk mitigation actions by Mitigation Structure (Primary Mitigation, Secondary Mitigation, and Contingencies); the latter is discussed below.

Primary Risk Mitigation Recommendations

Primary risk mitigation occurs throughout the various project phases and is the result of the planned actions of the Project Sponsor and its contractors as described in the RCMP portion of the PMP. Primary risk mitigation takes the form of an action plan, with specific activities to be undertaken in response to identified risks. These action items are often categorized by such things as SCC codes, risk category and mitigation type, and generally include required completion dates and responsibility assignments.

Primary mitigation activities are scheduled at the earliest phase during which the mitigation activity may occurs (requirements, design, procurement, or construction), and are expected to be completed on a timely basis to achieve the cost-risk and schedule-risk parameter targets at the end of that phase. Examples of primary risk mitigation might be resolving an uncertain NEPA requirement, or expanding a geotechnical survey, etc. As the project proceeds, the ability to recover from loss decreases, so timely action is important. FTA has found that without this up-front analysis there is a tendency to over-rely on the project contingency.

Primary risk mitigation measures often include actions related to risk transference, where risks are transferred through construction contracting; all the while ensuring that risk remaining with the Project Sponsor is fully recognized and effective risk response plans are developed. The Project Sponsor's project delivery methods and contracting plans, including its proposed terms and conditions, should offer a comprehensive approach to ensuring that all forms of third party compensation (especially non-competitive, negotiated compensation) and risk transference are aligned with the project estimate and schedule.

Primary schedule risk mitigation recommendations should specifically treat both critical path and non-critical path activities. Frequent changes in the configuration of the project's critical path are disruptive and degrade the Project Sponsor's ability to effectively and efficiently implement the project. One role of primary schedule risk mitigation is to protect the project's critical path so that non-critical path activities do not become critical. The primary objective of primary schedule risk mitigation is to maintain a necessary amount of path float between the project's critical path activities and all of the intersecting (or potentially intersecting) paths. In other words, primary schedule risk mitigation "buffers" the critical path and preserves the schedule. A secondary objective of primary schedule risk mitigation is to keep significant risks (such as technical construction process risks) off of the project's critical path or minimize their duration if they are critical path activities. The general principle is that activities with high schedule risk should start and complete as soon as feasible.

Secondary Risk Mitigation Recommendations

Secondary risk mitigation consists of pre-planned, potential scope or process changes that may be triggered when risk events occur that require reduction of contingencies below minimum levels. Secondary risk mitigation is fundamentally different than value engineering, which is a formal, systematic, multi-disciplined process designed to optimize the value of each dollar spent.

FTA will develop recommendations (or "targets") for secondary risk mitigation capacity that should be developed by the Project Sponsor for the project phase under consideration. It is often the case that, as a project progresses toward completion, it may become increasingly difficult to develop substantial amounts of Secondary Mitigation capacity, especially as the project enters construction; if sufficient secondary mitigation items are not available, additional contingency will likely be required to account for the insufficiency. FTA will work with the Project Sponsor to take into consideration the current status of design and the effect that any development of secondary risk mitigation measures may have on the project scope or possible reduction to the intended and approved transit capacity and level of service.

Project Cost Contingency Recommendations

Contingencies are estimated set-aside amounts (monetary set-asides for cost and time set-asides for schedule) that are included within the overall cost or schedule targets for the project. Contingencies are designed to be used to overcome increases in cost or schedule that are due to potential risks, and for which no other mitigation measure is available. These contingency amounts may be associated with a particular activity or category of cost (e.g. allocated contingency), or may be set aside in a general fund (unallocated contingency). As a general rule, the amount of risk a project faces reduces as the project progresses toward completion, therefore, it is expected that the amount of contingency required for a project will decrease commensurate with the project's progress over time.

FTA provides a detailed method to determine the adequacy of the Project Sponsor's cost contingencies, beginning with the phase for which the most recent risk modeling is completed and extending to future project phases. The Project Sponsor risk analysis or the FTA "top-down" model (described above) provides the contingency recommendation for the current phase. Future phase minimum contingency amounts are determined to develop a time-based contingency draw-down curve, against which remaining contingency may be tracked. If remaining contingency at any point in the future falls below this curve, then the project is consuming contingency at a too-rapid rate, and must make plans to resolve the situation.

The parameters of the contingency drawdown curve for future phases are established as follows: 1) a "forward pass" establishment of future contingency targets, using historically-developed parameters (described below); and a "backward pass" establishment of contingencies using project-specific information (also described below). FTA uses its professional judgment to evaluate the contingency requirements estimated by these approaches, and then works with the Project Sponsor to establish an overall set of minimum contingency levels.

In the Forward-Pass cost contingency analysis, FTA has developed a set of minimum recommended cost contingency values for key milestones where there are historically significant changes to project risk. The recommended cost contingency values, as outlined below, reflect amounts of contingency that are calculated as percentages of the total adjusted, stripped YOE cost estimate (excluding finance costs), and these should generally be included in the total estimate for the milestone noted. These milestones include:

- At Entry to Engineering, 25 percent.
- At Readiness to Bid Construction, 15 percent.
- At Start of Construction, 10 percent.
- When construction is 50 percent physically complete, the working target for total contingency is 5 percent.

The forward-pass contingency recommendations can be interpolated, based on the standard recommendations above, if additional milestone points are deemed appropriate by either the Project Sponsor or FTA.

FTA will consider whether the previous standard recommendations should be adjusted due to actual mitigation that has been achieved by the Project Sponsor, the known capacity of the contingency to absorb risk, risks identified by phase in the risk register, and unique project conditions; this process is called the "backward pass". In the case of

Backward-Pass cost contingency analysis, FTA develops or reviews a Project Sponsor-developed set of recommended cost contingency values that represent adjustments from the minimum standard amount of total cost contingency expected to be necessary at project milestones. The estimates of project-specific minimum total cost contingencies are based upon assessment of the project status and project risk. Items identified with the mitigation type of "risk acceptance" (that is, risk that is neither transferred or are unmitigatable) will be strongly considered when performing the backward pass analysis.

This process begins by considering the final stages of the project (say 95 percent complete) and determining how large a contingency fund should remain in the project budget to solve potential risk-laden events. This amount – often established through the judgment of both FTA and Project Sponsor project experts – becomes the minimum amount of contingency that should be maintained at that point. The next step is to consider another point in time when the project is less complete (say at 75 percent completion) and to similarly determine the size of contingency fund that should remain available. This process is not complete – moving stage by stage toward the beginning of the project – until it appears that primary risk mitigation or secondary risk mitigation, or both, will be sufficient to recover from potential cost overruns. This backward pass process is often more effective at latter stages of the project, when project detail has been significantly developed.

FTA and the Project Sponsor will agree on minimum levels of contingency that must be maintained at various phases of the project by utilizing information developed from the Project Sponsor's risk analysis or the FTA "top-down" model, the forward pass, and backward pass contingency analysis Based on the outcomes from each of the these models, the Project Sponsor, in discussion with the FTA, selects minimum current and future contingency levels that most reasonably reflect the specific project conditions. These minimum levels are indicated for each of the project milestones at which significant changes in risk may occur. These milestones, along with their minimum contingency levels, are termed "check points", and are used to protect the project from inappropriately early draw down of contingency funds. Experience has shown that tracking actual contingency remaining against such a contingency drawdown control curve serves as an important early warning system that indicates whether project changes are exceeding expectations.

Project Schedule Contingency Recommendations

The Project Sponsor will identify, describe, and analyze the adequacy of the Project Sponsor's schedule contingencies; the FTA will review and assess these contingencies. The schedule contingency review is developed similar in manner to that of the cost contingency review resulting in the identification of minimum amounts of schedule contingency for inclusion in the Project Sponsor's PMP and supporting schedules.

In this review, similar to what is done for cost, FTA uses TRB studies and historic experience to recommend time contingency to add to the stripped, adjusted schedule. Through the risk identification and quantification process, FTA is able to identify whether and where the Project Sponsor is likely to face risks and whether or not the Project Sponsor has tools in place to address these risks. FTA discusses this schedule risk review with the Project Sponsor so that there is a clear understanding of where and why FTA sees the risk occurring.

Forward-Pass schedule contingency analysis involves developing a recommendation based on the following historically-grounded fundamental assumptions:

- The project should follow the general guideline that sufficient schedule contingency is available at Entry to Engineering to absorb a project schedule delay equivalent to 25% of the duration from Entry into Engineering through the Revenue Service Date proposed for the FFGA, calculated by adding the schedule contingency to the Adjusted Schedule. Where the schedule risk analysis is performed after Entry to Engineering, an assumption may be made that the 25% schedule contingency amount applies to remaining duration from that point until the proposed Revenue Service date.
- Any available schedule risk assessment histogram indicates a confidence level of at least 65% of reaching the proposed FFGA Revenue Service Date (RSD); and
- The general assessment of risk is not in conflict with the risk contingency requirements established in development of the Schedule Contingency Draw-down Curve, below.

Backward-Pass schedule contingency analysis involves "stepping back" sequentially through various completion milestones for the project and estimating the minimum amount of schedule contingency required to complete the project on schedule, in consideration of risks identified in the risk analysis.

FTA, in discussion with the Project Sponsor, will develop a recommended amount of minimum total schedule contingency at the current and forward phases to be available for the project at each major milestone. These minimum levels are indicated for each of the key FTA milestones, including additional milestones as identified for points of time at which significant changes in risk may occur. These milestones and minimum schedule contingency amounts are used to develop a schedule contingency drawdown control chart of " check points," which is used to track remaining contingency against and protect the project from inappropriately early draw down of contingency durations.

Managing the risk process

The Project Sponsor is responsible for establishing and monitoring its process of risk management in the Risk and Contingency Management Plan (RCMP). Pro-active, continual management of risk prevents risk events from becoming crises. Many Project Sponsors find it important to have an independent risk management staff that reports primarily to a level above that of the project manager. This avoids conflicts of interest that occur when cost and schedule compliance responsibilities conflict with the candid reporting of some likelihood of not meeting these goals.

The RCMP must describe the process by which cost risk and schedule risk will be identified, analyzed, managed, and monitored by the Project Sponsor's project management team on a continuous basis during the life of the project. Pro-active, deliberate and continual management of risk is one of the key elements in ensuring the most efficient path toward reaching the project's goals. In FTA's experience, projects are more prone to cost overruns and schedule delays when Project Sponsors treat the risk register and corresponding risk mitigation measures to be static once developed. Continual review and updating of the risk register is a necessary component of a robust risk management program. As identified risks are brought to closure, the Project Sponsor needs to ensure there is agreement with FTA that the risk has been satisfactorily averted, mitigated, protected against, or otherwise resolved and that the risk can be closed.

The RCMP also describes how the project's contingencies will be managed and protected by the Project Sponsor. As discussed earlier in this appendix, it is especially important that "check points" established in contingency drawdown curves be closely monitored to ensure sufficient amounts of cost and schedule contingency are preserved for the duration of the project. Other critical aspects of contingency management include identification of persons with the authority to distribute, transfer, and use contingencies, the manner in which the Project Sponsor forecasts and trends the project's contingencies, and recovery plans should contingency levels fall below, or be forecasted to fall below, the established contingency drawdown curve.

Sponsors are responsible for documenting and reporting risk management activities to the FTA on a prescribed basis. This should include any changes made to the risk register, cost or schedule contingency levels, or both, change in the status of any active risk mitigation measures being employed, and any updates to the RCMP. Updates to the RCMP are necessary to maintain the document's integrity and usefulness. At a minimum, Project Sponsors should refresh the document at significant milestones (i.e., a major design deliverable is reviewed, a major contract is awarded, all underground construction is complete, etc.). FTA may perform post-assessment monitoring to determine whether the Project Sponsor's risk management activities achieved the risk management objectives and targets established in the RCMP.

Post-assessment monitoring is intended to assess the Project Sponsor's performance in risk management and ensure that the Project Sponsor's project implementation achieves its risk management objectives and targets. FTA uses the Project Sponsor's RCMP as its guide for post-risk review monitoring.

APPENDIX F – UTILITY RELOCATION AGREEMENTS

Introduction

The utility and transportation industries are often linked through shared ROW, state and federal safety oversight, and a measure of economic regulation. Transit "New Starts" frequently require the relocation of utilities just as federally supported highway construction has for many years. In recognition of this long standing interaction, "utilities" are defined in 23 CFR, Part 645, Subpart B, Section 645.207 as a "privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, storm water not connected with highway drainage, or any other similar commodity, including any fire or police signal system or street lighting system, which directly or indirectly serves the public." The term utility shall also mean the utility company inclusive of any wholly owned or controlled subsidiary.

A "utility agreement" is a legally binding document between a utility company and a transit agency that defines the scope of a relocation, including reimbursement, liability, right of entry, insurance, and schedule to complete the work. Such an agreement is essential to properly identify the parties involved and to ensure that all parties have a complete understanding of the scope, schedule, and reimbursement issues relating to the relocation. Utility agreements have long been the means by which a transit agency arranges for a Utility to relocate its facilities from within the footprint or that is considered for safety or other tangible reason considered too close to the proposed operation of a proposed transit project.

Policies and Practices

It is extremely important that utility agreements be thoroughly reviewed by in-house counsel and engineering staff to ensure that all necessary information is included. For this review to occur the agreement must be completed well in advance of the start of construction. Cost and schedule penalties can be severe when construction activities and utility relocations occur concurrently.

Development of the Utility Agreement

The first step required for any utility relocation is to solicit utility maps from all known utility companies in the area under consideration. It is helpful to have a master list of utility companies and mail letters of intent to all of them asking for maps of any known utilities in the project limits. Subsurface Utility Engineering (SUE) is the process of accurately and comprehensively mapping all underground utilities. This method should be utilized, as budgets allow, assisting in locating all utilities. After this preliminary effort, the utility locator company in the area is contacted and a request is made for all of the utilities to be marked in the field. This information is used, along with the preliminary survey information collected, to ensure that all utility locations are known, and are accurately identified on the field survey.

After all affected utilities have been identified, a determination of the most desirable location for their relocations should then be performed. Begin discussions with the Utility and determine if the Utility has a policy of relocating its own utilities or if it wants the relocation performed under the relocation activities of the project. Determine who is responsible for the relocation costs. A general review of existing license agreements will be necessary to make this determination. If costs are to be covered by the Project Sponsor, determine what these costs are up front, and begin negotiations.

As design of the transit project continues, and project alignments become known, initial work on the utility agreement should begin and increased coordination and negotiations with the affected Utility should follow. The most ideal situation is to have signed agreements and all utilities relocated prior to the general contractor receiving a Notice to Proceed (NTP) on its construction contract. If this is not possible, all affected utility facilities need to be shown in the project documents and relocation will be made concurrent with the construction activities. Coordinating the availability of the construction site with the general contractor and the Utility will be very important. Ensuring each has access to the site as promised will help to avoid any future litigation.

The next steps involve setting up a Utility pre-construction meeting, monitoring the relocation work of the Utility, and providing oversight of their progress. Any slip in the schedule of the utility relocation will have the same detrimental effect as any slip in the schedule of the individual construction contract. Finally, the Project Sponsor should inspect the utility relocations to ensure that all work is performed according to the Project Sponsor's expectations.

Utility Relocations During the Project Design Phase

Utility relocation must be properly coordinated with other phases of project development, ROW acquisition, and construction in order that conflicting utilities are removed or adjusted prior to construction or in a manner that will not interfere with the construction scope of work or its schedule. The scope of the utility relocation must be determined as well as the responsibility for costs of the relocation. Of particular importance is the avoidance of what are known as "betterments" in the scope of work, as these are ineligible for FTA funding participation.

The costs of the relocation are not always borne by the Project Sponsor. In many instances, utilities are located in public rights-of-way under what is effectively a "franchise" agreement, and often such agreements require the Utility to relocate at its own expense. If the former is not the case, cost sharing must always be considered as a feasible alternative to the project being charged. A review of the project plans must be made, relocation estimates checked, agreements prepared and relocation costs negotiated and agreed upon. The scheduling of the relocation must be made to coincide and agree with other all impacted contractors on project right-of-way. Numerous contractors on the project, all performing work independently, will often present scheduling issues, the potential for claims is increased, and the real possibility of contractor disputes may arise.

It is the responsibility of the Project Sponsor utility staff to coordinate utility relocations on proposed projects with other phases of ROW acquisition and with construction in order that conflicting utilities are removed or adjusted prior to construction or in a manner that will not interfere with construction. The staff must determine the scope of utility relocation required as well as the responsibility for costs of the relocation. Utility designers must secure, review, and process plans. Also, they must review estimates and reimbursement agreements covering the relocation or removal of conflicting utilities.

23 CFR 645.109 considers the application of value engineering to utility relocations. In one particular case, under a lump sum utility agreement, a Utility later proposed a cost saving alternate solution. The Utility identified this as a value engineering savings and proposed that it share in the savings. The net impact would be to provide cash to the Utility. Value engineering incentives are supported in the customary Project Sponsor-contractor relationship. However, VE incentives should not be applied to the typical Project Sponsor's-Utility relationship for utility work where the Utility is the "owner" and, therefore, the organization responsible for setting up the means for rewarding creative ideas. In no case should the relocation or adjustment of facilities result in a cash windfall to the Utility.

Scheduling Agreements

It is never too early to negotiate and execute utility agreements. Usually, however, the status of the design and the requirements of the Utility will control when the agreement can be negotiated. The DEIS/FEIS phase usually aids in the identification of which utilities are affected by the proposed transit project. As early as is economically feasible, the Project Sponsor must contact all affected Utilities to inform them of the proposed improvements and obtain their criteria for relocating or protecting their respective facilities. Some Utilities insist on performing their own design, while others insist that firms pre-qualified by the Utility perform the design and the actual relocation work.

Utility Agreement Language/Content

Utility agreements should contain a detailed description of the scope of work to be accomplished. Providing design drawings, which accurately depict the existing conditions and the post-construction conditions, contribute extensively to describing the scope of work. The extent of the relocations must be clearly shown.

Many utility companies have their own design staff and are capable of designing the relocation themselves. If this is the case, the parameters of the relocation must be clearly identified in the agreement so that the designers have all the necessary information needed to conduct their design. Design reviews, constructability reviews, and continual coordination are essential with each Utility to ensure that all relocations are performed as expected.

Many utility companies are also capable of performing their own relocation. Again, this should be referenced in the utility agreement and the schedule becomes very important because the Utility often has priorities that are not the same as the construction project. The Project Sponsor should, in such instances, also seek in the agreement provisions for both cost and schedule accountability from the Utility so as to offset any schedule delay and associated costs if and when a project construction contractor is negatively impacted and that contractor seeks relief (delay claim). Progress monitoring is essential for relocation work performed by the Utility.

It is important that all relocated utilities are moved, protected, and constructed to meet all applicable codes. Whether the utility is relocated by the Utility or by the Project Sponsor's general contractor, proper inspections must be performed to ensure adequate construction. The party responsible for this vital function needs to be identified in the agreement.

Ideally, the relocation costs are negotiated up front, before the relocation work takes place. This enables the Project Sponsor to properly budget all costs related to relocation. The lump sum method of payment is beneficial because it reduces the administrative and record-keeping costs associated with documenting payment for completed work. However, these savings may be offset by inaccuracies in the cost estimating process. The lump sum payment method should only be used where the end product, in this case the utility relocation, can be clearly and concisely defined. The cost estimate in support of the lump sum agreement must be accurate, comprehensive, verifiable, and in sufficient detail to give a clear picture of the work involved and the cost of the individual items.

If reimbursement is to be made on a cost reimbursement basis, this too must be determined and necessary line items and unit costs developed before the relocation work is performed. A method for settling claims and a conflict resolution method should also be included in the agreement.

Finally, the schedule must be specified and completely understood by all parties. If multiple contractors will have access to the site, this must be identified and agreed to in the agreement. It is ideal to have the relocations substantially completed prior to the general contractor receiving NTP. However, this is not always possible, and when it is not, extensive coordination and written documentation must clearly define the expectations of all parties involved.

Agreements and Authorizations, as identified in 23 CFR 645.113, state that the agreement should be supported by plans and/or drawings that show:

- The location, length, size and/or capacity, type, class, and pertinent operating conditions and design features of existing, proposed, and temporary facilities, including any proposed changes to them, using appropriate nomenclature, symbols, legend, notes, color-coding
- The project number, plan scale and date, the horizontal and, where appropriate, the vertical location of the utility facilities in relation to the highway alignment,

geometric features, stationing, grades, structures, and other facilities, proposed and existing ROW lines, and, where applicable, the access control lines
- The limits of ROW to be acquired from, by, or on behalf of the utility, where applicable
- The portion of the work to be accomplished, if any, at the sole expense of the Utility, using appropriate notes or symbols
- The agreement should also include a cost estimate for the proposed work. The cost estimate should set forth the items of work to be performed, broken down by the estimated costs of the following:
  - Direct labor
  - Labor surcharges
  - Overhead and indirect construction charges
  - Materials and supplies
  - Handling charges
  - Transportation
  - Equipment
  - ROW
  - Preliminary engineering
  - Construction engineering
  - Salvage credits
  - Betterment credits
  - Accrued depreciation credits

The estimate should include sufficient detail to provide the Project Sponsor with a reasonable basis for analysis. Factors included in the Utility's overhead and indirect construction charges should be set forth. Materials should be itemized where they represent relatively major components or cost in the relocation. Unit costs, such as broad-gauge units of property, may be used for estimating purposes where the utility uses such units in its own operations. Typically, a Utility uses its own forces or those of a utility contractor to accomplish the needed adjustments to its facilities. Records of actual costs incurred should form the basis for reimbursement.

Negotiation and Reimbursement

Only actual allowable, allocable, and reasonable costs are reimbursable. Where the work is to be performed by the public utility's forces, no profit is allowed and reimbursement is limited to the amount necessary to relocate and/or rearrange the facilities to affect a condition equal to the existing utility facilities. Generally, reimbursement would not provide for greater capacity, capability, durability, efficiency or function, or other "betterments", except for meeting current state and local codes. The cost estimate should contain, at a minimum, the labor type along with hours and hourly rate, equipment type and rates, material quantities and costs, and engineering costs.

If a Utility elects to improve, change, rearrange, or otherwise enhance its facilities beyond that which currently exists, the Project Sponsor should obtain separate estimates to identify the cost difference between the improved adjustment and the adjustment that is comparable to the existing facility.

Utility agreements must accurately reflect the costs of the activities involved. Acceptable methods for developing relocation costs include:

- Actual direct and related indirect costs accumulated in accordance with a specified work order and in accordance with a jointly approved procedure for documenting those costs
- An agreed upon fixed amount (lump sum) payment
- An agreed unit cost method of payment

When the Project Sponsor is obligated to reimburse a Utility for the removal or alteration of its facility, all parties should understand that the adjustment is to be undertaken in the most economical manner consistent with good engineering practice and in compliance with applicable codes and permit regulations. The Project Sponsor should only reimburse the Utility for comparable facilities. If the Utility elects to improve its facility during the adjustment (i.e., a utility betterment), the Project Sponsor should strive to only reimburse the company for the cost of a comparable facility. No cost for “betterments” are reimbursable with FTA funds.

Conclusion

The most important element to successfully negotiate every utility agreement is to begin the process early. By accurately locating all utilities through surveys, SUE and general inquiries early in the design process, more time is available to negotiate and coordinate the content of the utility agreements. Coordinating and meeting often with the affected Utilities ensures that the entire process is progressing and the eventual outcome has a greater chance of being successful. Proper oversight of the Utility activities is essential to maintaining the project schedule and ensuring that Utilities are relocated in a manner that meets the transit project objectives.

It is important to employ people who have experience and are adept at all aspects of utility relocation. Many things can delay the relocation of an important utility. It is essential that management of the utility relocation efforts be given the same amount of manpower as design and construction oversight activities. Simply signing a Utility Agreement and then allowing the Utility to monitor itself is not an effective plan for the Project Sponsor. Constant oversight and coordination is essential. Knowledgeable staff is also better prepared to estimate relocation costs and successfully negotiate with the Utility.

Utility companies often operate at their own pace and under their own set of rules. For these reasons, it is more important than ever, that the Project Sponsor do everything within its capability to effectively evaluate the work to be done, oversee, negotiate, and monitor all of the utility relocations performed by Utilities, just as the grant must do with its other construction contracts.

U.S. Department of Transportation
Federal Transit Administration

U.S. Department of Transportation
Federal Transit Administration
East Building
1200 New Jersey Avenue, SE
Washington, DC 20590