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Transportation
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QUALITY ASSURANCE AND QUALITY CONTROL GUIDELINES

March 1992
Final Report

Prepared for the

Office of Technical Assistance and Safety

by:

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16. Abstract

The Federal Transit Administration (FTA) sponsored the development of the Quality Assurance and Quality Control Guidelines to provide a resource for local transit authorities and others undertaking capital projects. The FTA requires grantees undertaking major capital programs to prepare a Project Management Plan (PMP) which includes a Quality Plan. Even for those projects not considered major, a Quality Plan can be a useful management tool for guiding activities to assure project quality.

Chapter 1 presents definitions, and provides a historical overview of quality in capital projects. Chapter 2 presents 15 elements which should be the basis of a quality policy. These elements include 1) Management Responsibility, 2) Documented Quality System, 3) Design Control, 4) Document Control, 5) Purchasing, 6) Product Identification and Traceability, 7) Process Control, 8) Inspection and Testing, 9) Inspection, Measuring, and Test Equipment, 10) Inspection and Test Status, 11) Nonconformance, 12) Corrective Action, 13) Quality Records, 14) Quality Audits, and 15) Training. Chapter 3 presents alternative organizational approaches to a quality system. The choice of approach depends upon the type of capital project, the size of the project, and the use of consultants for project management. Chapter 4 discusses the development of the Quality Plan throughout the different project phases from project planning, preliminary engineering and final design, construction and equipment procurement, and testing and start-up. The appendices provide selections of quality elements from several transit quality programs.

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METRIC / ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectares (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gr)
1 pound (lb) = .45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

$[(x - 32)(5/9)]\ °F = y\ °C$

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 hectare (he) = 10,000 square meters (m^2) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gr) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

VOLUME (APPROXIMATE)

1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

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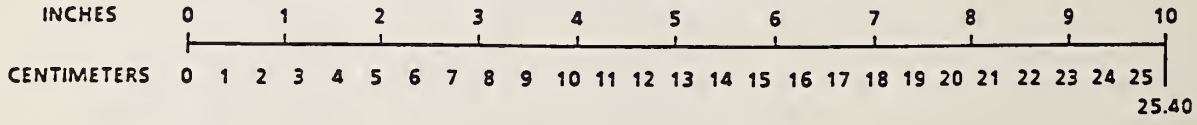
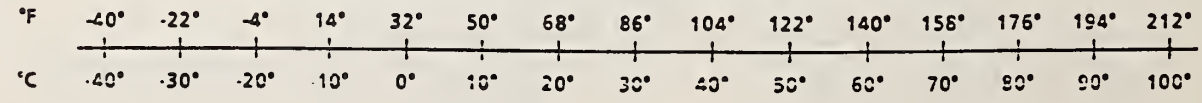
QUICK INCH-CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT-CELCIUS TEMPERATURE CONVERSION



For more exact and/or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10 286.

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EG&G Dynatrend Inc. was the prime contractor under the direction of Jeffrey Mora, Program Manager, in FTA's Office of Technical Assistance and Safety. Mr. Mora and Mr. Frank McCarron of the FTA Office of Grants Management provided ongoing guidance for this project. Karla Karash was the Project Manager and author of the Guidelines. She was assisted by Thomas Luglio, Jr. who provided welcome advice and comment throughout the effort.

Fluor Daniel, Inc. was a subcontractor under the direction of A.T. (Tom) Lewis. R.W. (Dick) Cowles of Fluor Constructors International, Inc. helped shape the Guidelines content, and also provided invaluable comments on this document.

The appendices of these Guidelines contain selections from Quality Assurance and/or Quality Control Programs written by several FTA Grantees. These include the Long Island Rail Road, the Chicago Department of Public Works Southwest Transit Project, and the Los Angeles Rail Construction Corporation.

Two workshops were organized by EG&G Dynatrend and Fluor Daniel to present the contents of the Draft Guidelines. Thomas Luglio provided overall strategic advice, and Elizabeth Borg provided assistance with the workshop logistics. Karla Karash was the overall workshop moderator, and Barry Dawson of Fluor Daniel and Richard Cowles of Fluor Constructors International were major presenters. Frank McCarron of FTA Grants management provided a historical overview of the FTA effort to encourage quality systems in FTA capital projects.

The lead speaker at both workshops was Michael Cobb, Director of Quality Assurance for the Long Island Rail Road. Mr. Cobb's presentation of quality efforts at the Long Island Rail Road was an inspiring lead-in to the rest of the workshop. The following workshop

guest panelists each made a stimulating presentation from different project perspectives on the organization of quality programs and lessons learned:

o Frank Cirigliano	O'Brien-Keitzberg, on the Construction Manager's role in quality assurance for the Guadalupe Corridor Project.
o Victor O'Blas	Superintendent of Engineering and Construction, Seattle Metro, on Metro's quality program for the Downtown Seattle Tunnel Project.
o Malcolm Ingram	Director of Quality Assurance for the Rail Construction Corporation, on quality assurance in procurement for the Los Angeles rail construction program.
o Richard Cowles	Fluor Constructors International, on quality assurance and quality control in project design.
o Barry Dawson	Fluor Daniel, on quality assurance and quality control for a small project.
o Charles Stanford	Assistant General Manager for Engineering and Construction, Greater Cleveland RTA, on quality assurance and quality control with grantee construction management.
o Edward Hughey	Director of Program Operations, Long Island Rail Road, on quality assurance and quality control with a Construction Management Consultant.
o Robert Collier	Manager of Quality Assurance for Transit System Development, MARTA, on quality assurance and quality control in procurement.

The workshop participants provided many excellent comments and suggestions on the Draft Guidelines, and many of these have been incorporated into the final document. Portions of the presentation by Barry Dawson and Dick Cowles at the workshops were incorporated. In addition, Barry Dawson's example of a small project quality program was added as an example in Chapter 3.

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LIST OF ACRONYMS

AA	Alternatives Analysis
ANSI	American National Standards Institute
ASQC	American Society of Quality Control
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
CII	Construction Industry Institute
CMC	Construction Management Consultant
DCQI	Design and Construction Quality Institute
DOD	Department of Defense
FHWA	Federal Highway Administration
FTA	Federal Transit Administration - previously the Urban Mass Transportation Administration (UMTA)
LIRR	Long Island Rail Road
PE	Preliminary Engineering
PMO	Project Management Oversight
PMOC	Project Management Oversight Contractor
PMP	Project Management Plan
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
RCC	Rail Construction Corporation
RE	Resident Engineer
SEPTA	Southeastern Pennsylvania Transportation Authority
SWTP	The Southwest Transit Project of the Chicago DPW
TQM	Total Quality Management
TRB	Transportation Research Board
WMATA	Washington Metropolitan Area Transit Authority

EXECUTIVE SUMMARY

The *Quality Assurance and Quality Control Guidelines* are for Federal Transit Administration (FTA) grantees who are undertaking design, construction, or equipment acquisition programs. FTA requires grantees undertaking major capital programs to prepare a Project Management Plan (PMP) which includes a Quality Plan. Even for those projects not considered major, a Quality Plan can be a useful management tool for guiding activities to ensure project quality.

For grantees undertaking multiple projects, the development of a project Quality Plan should be an outgrowth of a functioning quality system. This system is comprised of a written quality policy, written procedures, a management which supports and takes responsibility for quality, and personnel who undertake quality assurance and quality control activities.

Chapter 2 provides a description of the elements of a quality system. These elements should be considered in the development of detailed quality procedures. The fifteen quality elements are as follows:

- Management Responsibility
- Documented Quality System
- Design Control
- Document Control
- Purchasing
- Product Identification and Traceability
- Process Control
- Inspection and Testing
- Inspection, Measuring, and Test Equipment
- Inspection and Test Status

- o Nonconformance
- o Corrective Action
- o Quality Records
- o Quality Audits
- o Training

Organization of the quality functions for a project should be tailored to the grantee's organizational needs and management structure. Chapter 3 discusses alternative approaches which depend upon the type of capital project, the size of the project, and the use of consultants for project management. Whatever the approach, the grantee has overall responsibility for an effective quality system and needs to maintain some oversight responsibility for the project quality.

Chapter 4 discusses the development of a project Quality Plan. This is an evolutionary process, during which different levels of detail are appropriate at the different project phases. The Quality Plan should be developed as part of the PMP at the end of the Project Planning phase, and should be modified as required to provide adequate project quality guidance during design, procurement, and construction. The authority and responsibilities of each component of the project organization need to be clearly defined, extending from grantee top management to consultants, suppliers, and contractors. The Quality Plan needs to provide details of the quality system requirements to be applied during the design process, including any quality assurance requirements to be placed on design consultants. The Quality Plan should define the quality system requirements to be placed upon construction contractors, construction management consultants (CMC), and equipment manufacturers. The Quality Plan should describe the quality oversight activities to be undertaken by the grantee.

CHAPTER 1
INTRODUCTION

1.1 Guideline Objectives and Background

Although the concepts of quality assurance (QA) and quality control (QC) have been around for some time, interest in such programs has increased during the last decade. One of the reasons for this renewed interest is the example of Japanese industry, which has used improved quality, among other programs, to become a major competitor in international trade.

In general, the construction industry has lagged behind manufacturing in the development of comprehensive QA/QC programs. The manufacturing industry, with its repetition of similar processes, can easily make use of statistical QC procedures, and it can continually experiment with process improvements. The construction industry, on the other hand, is often involved in "one of a kind" projects, for which standard industry QC procedures are more difficult to apply. Transit projects often involve both construction and manufacturing, and any quality guidance for such projects needs to apply to both types.

This report has been developed under the Federal Transit Administration (FTA) sponsorship to assist transit agencies in developing quality systems and plans for their FTA-funded transit capital improvement projects. FTA regulations require each FTA funded major capital program to submit a Program Management Plan (PMP) for FTA approval. These regulations also stipulate that a Quality Plan must be included as part of the PMP.

FTA maintains oversight for the grants which it awards, but assigns the grant administration and management responsibility to the grantees. FTA's Office of Grants Management

delegates the responsibility for oversight of nearly all capital grants to the appropriate FTA Regional Office.

The *Quality Assurance and Quality Control Guidelines* is one of several initiatives undertaken by FTA to enhance the management of the projects that it funds. The initiatives have included guidance to grantees on topics such as insurance, and value engineering; assignment of Project Management Oversight Contractors (PMOC) to provide technical support to FTA; and the development of the *Project and Construction Management Guidelines* [Ref. 28].

The *Project and Construction Management Guidelines* includes a brief description of QA as a part of a management control system. It suggests appropriate contents of a QA/QC program in preliminary engineering, final design, construction, testing, and start-up.

This *Quality Assurance and Quality Control Guidelines* document expands upon the QA/QC program guidance contained in the *Project and Construction Management Guidelines*. Its major purpose is to promote the development of grantee quality systems consistent with contemporary FTA practices to affect successful implementation.

Before undertaking this effort, information was gathered through the PMOCs to determine the state of QA/QC programs for FTA funded capital improvement projects. Some 40 different projects were covered in this investigation, ranging in dollar value from less than a million to several billion. The findings are as follows:

- Much progress has been made over recent years in developing and applying formal QA/QC programs. Nearly three-quarters of the grantees had either a documented QA/QC program, a strong QC program, or they utilized a CMC who had a QA/QC program. A majority of the formal written QA/QC programs were adopted in 1990.

- While less than half of the grantees had staffs dedicated to QA, this concept is growing. Many of the staffs which existed were newly formed.

- Substantive quality in the projects was found where there was enthusiasm for a quality program. Examples were found in old-line agencies and in newer agencies. These examples included a variety of QA/QC program types and staffing procedures.

- A formal written QA/QC program was particularly helpful for grantees with little experience in the particular project under construction. It was also helpful for old-line agencies which had evolved multiple quality programs that had not always proven effective.

- QA/QC is important in design as well as manufacturing and construction. Design errors are responsible for a large percentage of rework, so catching design errors has a high payoff.

- QA/QC programs seemed to work reasonably well in projects employing a CMC and an outside construction contractor. However, there was a need for the grantee to recognize their overall QA responsibilities, which cannot be delegated to the CMC.

The remainder of this chapter defines a number of the quality concepts, and gives a historic overview of their development and their relationship. It discusses QA/QC in the context of project and construction management, and provides an overview of how to use these guidelines.

1.2 QA/QC Definitions

Following are definitions of various terms used in the quality field.

Quality Policy	"The overall quality intentions and direction of an organization as regards quality, as formally expressed by top management." [Ref. 38]
Quality Management	"That aspect of the overall management function that determines and implements the quality policy." [Ref. 38]
Quality System	"The organizational structure, responsibilities, procedures, processes, and resources for implementing quality management." [Ref. 38]
Quality Procedures	Written instructions for implementing various components of the quality system. Procedures should identify what is to be done, who should do it, how, where, and when it should be done.
Quality Manual	The typical form of the main document used in drawing up and implementing a quality system. The quality manual should contain the quality policy and written procedures. In larger properties, there can be more than one quality manual. For example, there could be a corporate quality manual, divisional quality manuals, and specialized quality manuals for design, procurement, and construction activities, prepared by those responsible for the work.
Quality Plans	A written description of intended actions to control and ensure quality. The Quality Plan defines applicable quality policy for the project and applicable quality procedures. For new projects, Quality Plans should be developed consistent with all other requirements of a grantee's quality system.
Quality Program	The coordinated execution of applicable QA and QC plans and activities for a project.

Quality Control	"The operational techniques and activities that are used to fulfill requirements for quality." [Ref. 38] These techniques are used to ensure that a product or service meets requirements. QC is carried out by the operating forces. Their job is to do the work and meet the product or service goals. Generally, QC refers to the act of taking measurements, testing, and inspecting a process or product to ensure that it meets specification. It also includes actions by those performing the work to control the quality of the work. Products may be design drawings or specifications, manufactured equipment, or constructed items. QC also refers to the process of documenting such actions.
Quality Assurance	"All those planned and systematic actions necessary to provide adequate confidence to the management that a product or service will satisfy given requirements for quality." [Ref. 38] QA emphasizes "upstream" actions which directly improve the chances that QC actions will result in a product or service that meets requirements. QA includes ensuring the project requirements are developed to meet the needs of all relevant internal and external agencies, planning the processes needed to ensure quality of the project, ensuring that equipment and staffing is capable of performing tasks related to project quality, ensuring that contractors are capable of meeting and do carry out quality requirements, and documenting the quality efforts.
Quality Oversight (or Quality Surveillance)	A dictionary definition of oversight is "watchful care; general supervision." Quality oversight is conducted by an organization which is ultimately responsible for project quality where other organizations have been assigned QA and QC. Quality oversight can range from an informal process of keeping in touch with the QA organization to a second layer of QA activities, depending upon the circumstances. Quality oversight verifies the execution of the quality program. Quality surveillance means the same thing as quality oversight.
Total Quality Management	A organization-wide effort that involves everyone in the effort to improve performance. It makes quality a primary strategic objective. TQM is achieved through an integrated effort among personnel at all levels to increase customer satisfaction by continuously improving performance.

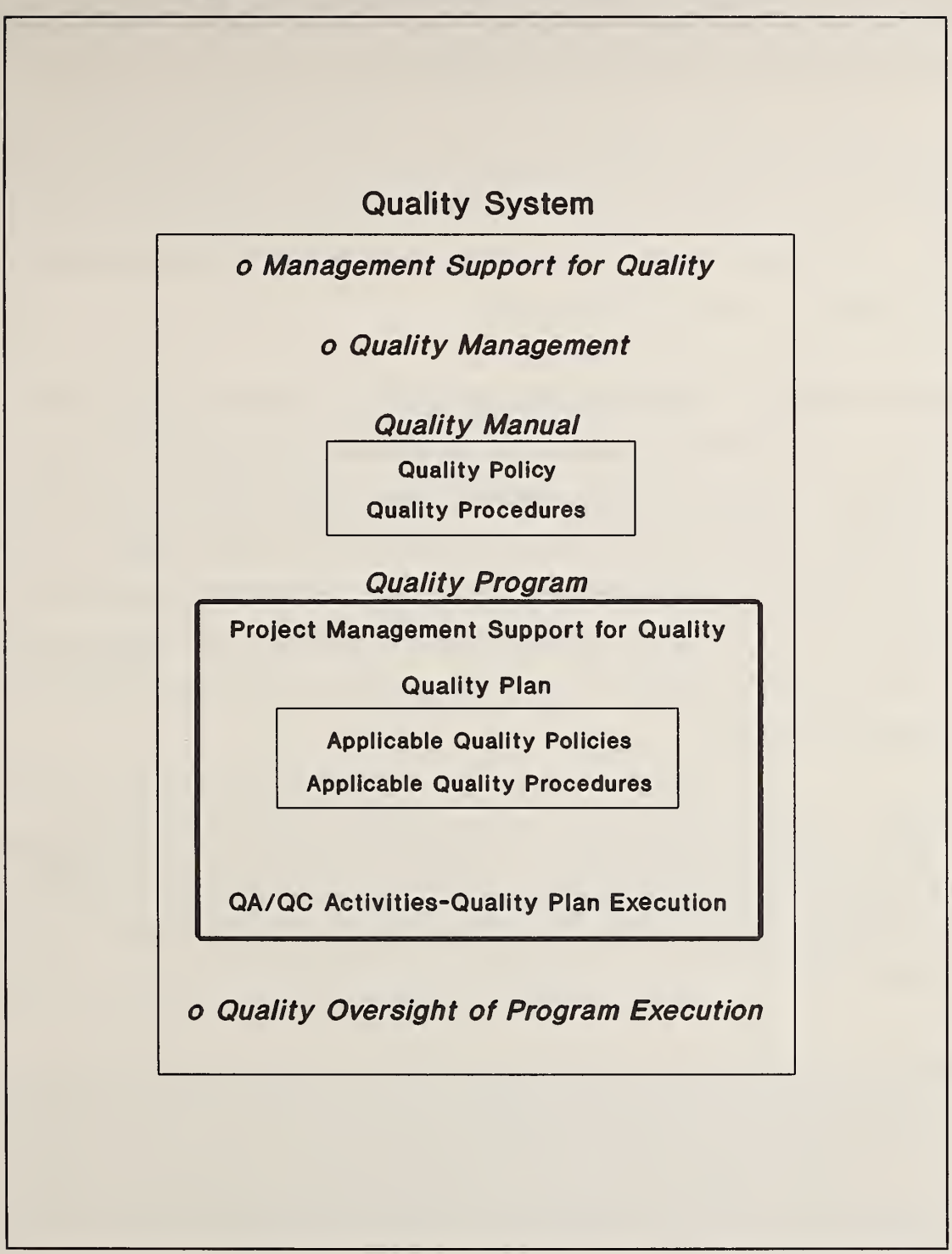
Figure 1-1 shows the interrelationship of a number of the concepts defined above. The quality system for an organization is composed of supportive upper management, quality

management, the written quality guidance or quality manual, the quality programs for individual projects, and quality oversight activities. The quality program for a project consists of project management support for quality, the Quality Plan, and the quality assurance/quality control activities required to execute the Quality Plan.

1.3 A Historical Overview of QA/QC and TQM

Dating back to the early crafts, product quality was a very personal product characteristic. Craftsmen earned their reputation by producing quality goods for each customer. With the industrial revolution and mass production, there was no longer a one-to-one relationship between craftsmen and customer. Specifications or standards for how to produce a product became the substitute for the craftsman's personal touch. QC was the function of inspecting the end product to determine if it met the specification or standard.

Figure 1-1 - Interrelationship of Quality Concepts



Standards became important not just to ensure that pieces fit together, but to ensure the safety of the final product. As early as 1914, the American Society of Mechanical Engineers (ASME) developed codes for boilers and pressure vessels. Use of these standards for boilers resulted in fewer failures, even as performance improved.

Quality standards began to be applied to the nuclear industry in the late 1940's, and in 1954 the ASME published ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities." This publication listed eighteen criteria for a QA program. In the nuclear industry QA refers to the entire QA/QC process.

Despite this earlier start, the real push for QA programs is thought to have come in the 1960's, when Robert McNamara introduced the concept in the Department of Defense (DOD) [Ref. 19]. McNamara wanted to cut the budget by transferring QC responsibility to DOD contractors, primarily manufacturers. DOD then had the QA responsibility where the purpose was to ensure that the contractors carried out QC. The idea eventually spread to the construction sector of DOD and the Corps of Engineers instituted its own program in the late 1960's. With the Corps program, the construction contractor is responsible for QC while QA is handled by the Corps.

By the 1960's, QA/QC programs could be found in defense, aerospace, pharmaceutical, electronics, automotive, and other industries. However, it was the Japanese who took these and other quality concepts in the post World War II era and made a giant leap in manufacturing quality.

The Japanese adapted the statistical QC procedures promoted by W. Edward Deming, and the managerial performance approach advocated by J.M. Juran. These concepts combined with a highly educated Japanese work force, and with the Japanese approach to continual quality improvement, led to Japan surpassing the United States in quality in the electronics and automobile industries.

The Japanese went beyond concepts of QC and reliance on inspection and testing, to the point where high quality work is expected from the start. Japanese corporations expect an extremely high level of quality from their suppliers, and long term relationships are built with those suppliers which can meet quality expectations. The Japanese use management techniques to involve the entire work force in quality improvement efforts. They make a continuing effort to understand the desires of the customers to ensure that they are building the right thing as well as building it right. Because of its broad scope, the Japanese quality programs have been described as TQM, rather than QA/QC.

TQM, QA, and QC represent a hierarchy. A quality program for inspection and testing of product is a QC program. The addition of QA activities should improve upstream processes as well as provide for verification of QC activities, and should greatly enhance the probability of compliance with quality goals. TQM will improve management procedures and processes in order to further improve quality and reduce costs. The transit industry appears comfortable with QC, but is in the beginning stages for establishing QA programs. It is for this reason that these Guidelines focus on QA and QC.

1.4 QA/QC in the Context of Project and Construction Management

The function of project and construction management is to ensure acceptable quality while executing the project on-time and on-budget. For an FTA grantee, acceptable quality has a broad meaning -- it means meeting the needs of the public, and satisfying all of the regulatory and operational requirements outside and within the agency.

The major reason for emphasizing the need for a Quality Plan in addition to the PMP is to explicitly recognize the importance of quality in constructed projects and in procurement. The job of project management is to control schedule, budget, and quality of a project. However, since schedule and budget are easy to measure, and thus have been the traditional

focus of management, quality processes have often been overlooked. The requirement for a specific Quality Plan for a project helps to address this imbalance.

1.5 How to Use these Guidelines

Chapter 2 of these Guidelines covers the fifteen elements of a quality system. The fifteen elements provide the basis for a quality policy, they state the principles of quality management, and they provide the topic areas for written procedures. They also provide the basis for project Quality Plans as applicable to the work being performed.

To establish the quality system, a grantee should first start with the development of a statement expressing the organization's commitment to quality. In addition to a general statement of commitment, the grantee should develop a policy which includes the fifteen quality elements as applicable to the work performed by the organization.

Where activities covered in the fifteen quality elements are expected to be similar for several grantee projects, detailed procedures should be developed. These procedures will specify for a generic project who is responsible, when quality related activities should occur, how they are to be done, and where they are to be done. The procedures may also provide suggested formats for documenting quality related activities. Once procedures have been specified, these and the quality policy become part of the quality manual. This document becomes the guide for planning and executing quality activities.

The first quality element is "Management Responsibility." Chapter 3 addresses this important element as it applies to FTA capital projects. The grantee is responsible for planning and implementing quality activities for a project. Typically the quality system for an FTA capital improvement project will involve several organizations. Responsibility for the different quality activities will most likely be spread among the organizations. Chapter 3 should be consulted in planning for project related quality management and organization.

Considerations in developing a Quality Plan for a project are covered in Chapters 2 and 4. Chapter 2 includes factors for determining which quality elements should be applicable to a particular project. Chapter 4 discusses the phases in the development of a Quality Plan. These phases parallel the development of the PMP, and provide for increasing the detail of the Quality Plan as it becomes relevant for guiding the quality activities of the particular project phase.

CHAPTER 2
ESSENTIAL ELEMENTS OF A QA/QC SYSTEM

This chapter discusses fifteen elements which are the basis for any transit QA/QC system involving design, manufacturing, and/or construction. In addition this chapter provides some guidance in determining which elements are appropriate for different projects.

The background section describes the origin of the fifteen elements, other efforts to develop construction oriented QA/QC standards, the justification for our adaptation of the fifteen elements, and organizational definitions required to understand the fifteen elements.

2.1 Background

The fifteen elements are adapted from the American National Standards for Quality Systems (ANSI/ASQC Q90 - Q94). The International Standards for Quality Systems (ISO 9000 - ISO 9004) are almost identical to the ANSI standards. These standards were issued in 1987.

While the ANSI/ASQC Standards may not be totally geared to construction projects, they generically represent sound management practice. Evidence of the acceptance of these standards to industry is the expected requirement that all companies doing business in the European Common Market will have quality programs that comply with ISO 9000 - ISO 9004.

A number of organizations have developed or are developing quality program standards specifically for construction. A description of these efforts follows.

In 1982, the ASQC formed a Construction Technical Committee to address construction quality. In 1987 a document, "Quality Management for the Constructed Project" was published. This document outlined the contents of a Quality Plan and the elements of a quality program in the construction industry. The ASQC document explains the responsibilities of the owner, architect/engineer, and contractor; and then describes a quality program of some twelve quality elements for the contractor.

The American Society of Civil Engineers (ASCE) has addressed the need for a quality standard in engineering and construction. In 1988, ASCE published the document "Quality in the Constructed Project." It is a comprehensive manual that addresses *management* of the many phases of design and construction projects from inception to operation and maintenance. Although some of the various elements of a quality system are addressed in the various sections of the manual, the focus of this document is not on the specific requirements of a QA/QC program.

The Construction Industry Institute (CII), associated with the University of Texas at Austin, was founded in 1983 to improve the cost effectiveness of the construction industry. It has published a number of booklets describing a quality performance measuring system, and describing the benefits of a TQM approach. CII recommends that companies institute an integrated approach of TQM and QA/QC.

In developing the QA/QC Guidelines for FTA, consideration was given to adopting one of the construction specific guidances described above. However, it was decided to use the more generic approach of the ANSI/ASQC Q90 - Q94 standards. The reasoning is as follows:

- This standard has been broadly accepted in the United States and in the international community as ISO 9000 - ISO 9004. There has not yet been universal acceptance of the various QA/QC guidances for the design and construction industry.

- The capital programs of the transit industry include design and construction activities and equipment procurement. The ANSI/ASQC Q90 standard sets forth a generic quality program based upon sound management practices which is adaptable to all transit capital projects.

- The organization and management of transit capital programs can take many different forms. Some transit agencies may do construction activities in-house, they may hire a construction contractor, or they may hire both a CMC and construction contractor. Given the variety of formats, the most useful quality guidance would seem to be to present the essential quality elements, and let the transit agency determine where the elements are appropriate, and which organizations should have responsibility for implementation.

The fifteen quality elements are adapted from some twelve to twenty quality elements included in the ANSI standards. These fifteen are the elements most relevant to an FTA grantee. The elements should be seen as good management practice to ensure quality of design, manufacturing, and construction services. They are applicable not only for quality programs of the FTA grantees, but for organizations providing goods and services to grantees.

Each of the elements may refer to QA or QC activities. QA activities include planning for quality activities and verifying that those activities were carried out. QC activities include the actual implementation of quality activities and the documentation thereof.

The elements sometimes refer to generic organizational entities which could be the transit agency/grantee or the construction contractor, for example, depending upon the role being played. Following are some of the generic organizational entities referenced in the quality elements:

Management	Management of the grantee or management of any contractor to the grantee.
Designer	The organization responsible for design. This could be the grantee itself, and/or a contractor providing architectural/engineering services.

Purchaser	The grantee or other organization responsible for specifying requirements for capital goods or services.
Supplier	Any organization providing products or materials for grantee capital projects. The supplier could be a product manufacturer, or a provider of raw materials.
Contractor	Any organization providing services or products to a transit agency under direct contractual agreement. The contractor could be part of the grantee organization in the case of force account work.
Subcontractor	Any organization supplying services or products under contract to a contractor. The subcontractor would not contract directly with the transit agency, but with a contractor or another sub-contractor.

2.2 The Fifteen Elements of a Quality Program

2.2.1 Management Responsibility

> ***The grantee 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 who shall have defined authority and responsibility for ensuring that the quality policy is implemented and maintained. Management should also identify those persons responsible for the quality assurance function and should define in writing the responsibility, authority, and interrelation of those persons.***

The responsibility for and commitment to the quality policy belongs to the highest level of management. Management should, therefore, declare and document its commitment to

quality. Management should ensure that the quality policy is understood, implemented, and maintained throughout the organization.

There should be a person designated as the representative of management who has the responsibility and authority to ensure that management's quality policy is implemented and maintained. Maintenance includes documented review of the policy at appropriate intervals to ensure that it remains suitable and effective.

Project personnel who have responsibility for ensuring or controlling quality should be identified and their interrelationships with project management defined. These relationships should be shown on an organization chart. In particular, the personnel should be identified who have responsibility to initiate action to prevent quality problems, to identify and record quality problems, to initiate solutions through appropriate channels, and to verify implementation of solutions to quality problems. Those personnel responsible for ensuring quality must be independent of those having direct responsibility for the work being performed. This can be accomplished satisfactorily if those ensuring or controlling quality report on level higher than those having direct responsibility for the work.

Comment:
A concern for the grantee is the assignment of responsibility for QA and QC. So far as possible, each organization involved in a transit capital project should be responsible for its own QC. Exceptions include the case where a grantee has its own materials testing laboratory and thus provides some QC for its construction contractors.

While consultants or contractors to the grantee can assume some responsibility for QA, this responsibility should not be completely delegated. The grantee should maintain a QA oversight capability to ensure that quality programs are working at the agency itself and within the supplier and contractor organizations.

The Army Corps of Engineers quality program is a successful model for construction projects. With the Corps program, the contractors are responsible for QC and the Corps is responsible for QA. The contractors may also have some QA responsibility as part of their own quality system.

2.2.2 Documented Quality System

> ***The grantee should establish and maintain a documented quality system to ensure project quality objectives are satisfied. The quality system requirements should extend to the grantee's suppliers and contractors as appropriate.***

Written procedures and instructions should be developed for activities affecting quality in design, procurement, manufacturing, and construction as applicable to the work performed. Procedures and instructions should also be developed for control of processes including inspection, testing, nondestructive examination, disposition of nonconforming product, corrective action, maintenance of quality records, quality audits, and training.

The procedures should contain a statement of the purpose and scope, and should contain any references to appropriate codes, standards, or specifications. In developing the quality procedures, consideration should be given to identifying and acquiring any inspection equipment, skills, or special quality processes needed to ensure quality performance. Inspection and testing techniques should be kept up-to-date. Where new techniques are being used for construction or manufacturing, adequate time should be allowed to develop appropriate QA procedures for the new techniques. The procedures and instructions should contain formats for the quality records needed to ensure that the procedures and instructions are followed and documentation requirements are understood.

Comment:

The quality procedures described above are generic to the design and construction industry. Each Project Manager (PM) for transit agency capital projects determines which procedures are applicable to the specific capital project.

2.2.3 Design Control

> ***The designer should establish and maintain procedures to control and verify the design of the transit systems in order to ensure that the design criteria, other specified requirements, and requirements of the 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.***

The designer should prepare a plan for design activities. The plan should identify who has responsibility for the different design parts, and who has the QA responsibility for design. The plan should identify the various organizational interfaces required between various groups producing and commenting on the design, and specify the information to be documented, transmitted, and regularly reviewed. The plan should specify how the operating and maintenance departments of the transit agency will interface with those producing the design.

Design input requirements should be identified, documented, and reviewed by the designer. Any ambiguity in the design input requirements should be resolved between the designer and those responsible for developing the requirements.

Design output should be documented. It should meet the input design requirements, include acceptance criteria, conform to appropriate regulatory requirements whether or not these have been stated in the design input requirements, and identify those aspects of the design which are crucial to the safe and proper functioning of the final product or system.

The designer should assign to competent personnel those activities required to verify the quality of the design. Design verification activities include the carrying out of alternative calculations, conduction and documenting design reviews, undertaking qualification tests and demonstrations, and comparing the design with a similar proven design, if available. Design reviews include reviews for constructibility, operability, and maintainability.

Appropriate procedures should be established for the identification, documentation, review, and approval of all changes and modifications to the design. This responsibility should extend to those responsible for construction or manufacturing to ensure compliance to design requirements and for development of "as-built" documents as part of the design documentation at the end of the project.

Comment:
Each group responsible for design should provide its own written QC procedures. These include peer review of drawings and check calculations. QA activities are performed to verify compliance to established QC procedures and to determine the effectiveness of the procedures in meeting quality program objectives.

The *Project and Construction Management Guidelines* uses the term "Control of the Configuration" to refer to control of design changes, and the related document control (see below). The following detail about configuration control is taken from the *Project and Construction Management Guidelines* [Ref, 28, page 3-25]:

> Appropriate procedures should be established for the evaluation, coordination, review, and approval of all changes and modifications to the configuration of an item after

establishment of a configuration baseline. A configuration baseline consists of the approved or conditionally approved technical documentation for an item as set forth in drawings and associated lists, specifications, and referenced documents. In an effective configuration control program, drawings are uniquely numbered and otherwise identified. Specifications follow a standard format and each paragraph is numbered and identified. Complete drawing lists are established and the total number of drawings, the titles of the drawings, the revisions status, and the dates the drawings were approved are recorded. Changes to approved drawings or specifications should only be made in accordance with established procedures. Permanent files are maintained of all contract documents which include historical information relating to all project changes. As the project becomes implemented, configuration control evolves to include the documentation of the completed improvement in terms of "as-built drawings."

2.2.4 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 users who require them.

Control of project documents includes the review of documents by authorized personnel, the distribution and storage of these documents, the elimination of obsolete documents, and control of changes to the documents.

Copies of the documents should be distributed so that they will be available at all locations which need them for effective functioning of the quality system. Obsolete documents should be promptly eliminated from each work location. Any superseded documents retained for the record should be clearly identified as such.

Changes to the documents and data should be reviewed by the same authorized personnel who reviewed and approved the original documents unless the control procedures specifically allow otherwise. Changes should be promptly distributed to all locations, along with a master list enumerating the current revisions of each document.

Following are examples of the types of documents requiring control:

- o drawings
- o specifications
- o inspection procedures
- o test procedures
- o special work instructions
- o operational procedures
- o qa program and procedures

Comment:
A useful tool for keeping track of project documents is the Design Output Index which lists every document developed for the execution of the project. The Design Output Index contains a listing of the latest revisions of the following:

- o drawings
- o technical specifications
- o special processes
- o test specifications
- o engineering change notices

2.2.5 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 and in accordance with these Guidelines.

The purchaser should establish a documented list of acceptable suppliers and contractors for the desired service or product, consistent with applicable procurement requirements. The purchaser should select suppliers or contractors on the basis of their being able to meet contract requirements, including quality requirements. The quality requirements placed on the supplier or contractor will depend upon the nature of the service or product.

The contract or purchasing requirements should clearly specify the expectations of the purchaser, including relevant standards, drawings, specifications, process requirements, inspection instructions, and approval criteria for materials, processes, and product. The purchasing documents should be reviewed and approved by a designated authority for adequacy of specified requirements prior to release. The purchaser of services or products should ensure that the supplier fully understands the contract, agrees with the contract, and has the capacity to perform as required.

Where construction or equipment procurement is involved, the contract between the purchaser and the supplier should specify the right of the purchaser or other authorized representatives to carry out inspection and testing at the source and upon receipt to verify that the work or product meets specifications. Such provision should not absolve the supplier of the responsibility to provide acceptable work or product, nor should it preclude subsequent rejection.

Where equipment procurement is involved, the purchaser should define, as appropriate, the means and methods for handling, storage, packaging, and delivery of product. The purchaser should establish procedures to receive, inspect, store, and maintain equipment procured. Any equipment which is damaged or is otherwise unsuited for use should be documented and reported to the supplier.

Comment:
Purchasing requirements apply to all contractors and suppliers, including consultants, construction contractors, and manufacturers. The purpose of this element is to ensure that purchasing requirements are clear and complete, and that they are understood by the supplier, and that appropriate quality elements are made part of the contract. Additional requirements such as on-site inspection and handling and receiving procedures may be required for construction or equipment procurement contracts.

The level of quality program specified in the contract will depend upon the complexity and importance of the service or product. For some projects all fifteen elements of this quality guidance might be specified. In other cases, the supplier might only be required to use its existing quality program.

2.2.6 Product Identification and Traceability

> ***Measures should be established and maintained for identifying and controlling 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.***

Physical identification and control should be used to the extent possible. Where physical identification is impractical, physical separation, procedural control, or other appropriate

means may be employed. Items which fail to possess identification, or items for which record traceability has been lost, or items which do not conform to requirements should be segregated to prevent use or installation. An item should be able to be identified by how it is marked or where it is located.

2.2.7 Process Control

> ***Suppliers and contractors should identify and plan the production and installation processes which directly affect quality and should ensure 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.***

To achieve accuracy and consistency in production and installation processes the quality program should provide for:

a) documented work instructions where such are needed to ensure quality, use of suitable production and installation equipment, a suitable working environment, personnel qualifications, and conformance with referenced standards/codes and Quality Plans.

b) monitoring and controlling of processes and product characteristics during production and installation.

Continuous monitoring and/or conformance with documented procedures is required during special processes, such as welding, nondestructive testing, and heat treatment, where the results will impact quality of the final product, but where inspection after the fact will not reveal the deficiencies.

Comment:

A major issue in Process Control is to ensure that work is performed in the proper sequence. For example, welds should be inspected before they are painted. Earth should be compacted before concrete is poured. Documented work instructions can help with sequence control where there is complex work, or when there are multi-disciplined interfaces.

2.2.8 Inspection and Testing

> ***Inspection and testing procedures should be planned and executed as necessary to verify quality. Procedures should be specified, implemented, and the results documented for receiving incoming product, for work in process, and for final inspection and testing.***

When products are delivered to the purchaser, it is the responsibility of the purchaser to verify they are in conformance with requirements. Verification should be in accordance with the Quality Plan or documented procedures. The extent of receiving inspection can vary with the amount of inspection at the source, the safety criticality of the product, and the confidence in the quality procedures of the supplier.

In-process testing and inspection of the work to verify conformance of an item or work activity to specified requirements should be in accordance with the Quality Plan or documented procedures. Both inspection and process monitoring methods should be performed, as necessary, to ensure that the specified requirements for the control of work processes and the quality of the item are being achieved throughout the duration of the work.

Final inspection and testing should ensure that all specified inspection and tests, including those specified for receipt of product or in-process work, have been carried out and the resulting data meet specifications. Final inspection and testing should be carried out and properly documented to ensure conformance of the finished product to the specifications.

Records should be maintained of the various inspections and tests to provide evidence that the product has passed inspection and/or test with defined acceptance criteria.

Comment:

Given that everything cannot be inspected, the following criteria are offered as guidance for what to emphasize in an inspection and testing program.

- o items or work affecting safety
- o long lead time items or custom manufactured items
- o high visibility areas

2.2.9 Inspection, Measuring, and Test Equipment

Inspection, measuring, and test 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.

Inspection, measuring, and test equipment used should meet the standards of accuracy for the measurements which are required. The equipment should be calibrated according to national standards where available, and to documented standards where no national standards exist. The equipment should be recalibrated at regular intervals, and the recalibration properly documented. A record of the equipment calibration status should be maintained.

The equipment should be properly maintained to ensure its fitness for use. When in use, the user should ensure that the environmental conditions are suitable for the use of the equipment. When inspection, measuring, or test equipment is found to be out of calibration, the validity of previous inspection and test results should be assessed and documented.

Comment:

If a piece of equipment is used for final acceptance and it is adjustable, if it can wear, or if it has tight tolerances, then it needs to be calibrated.

2.2.10 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.

The test and inspection status should be identified by means of markings, stamps, tags, labels, routing cards, inspections records, test software, physical location, or other suitable means. The status identification indicates the conformance or nonconformance with regard to inspections and tests performed.

2.2.11 Nonconformance

Procedures should be established and maintained to control nonconforming work, in order to ensure that such work is not inadvertently used or installed.

Nonconforming work should be identified, documented, and evaluated to determine appropriate disposition. Where practicable, nonconforming items should be segregated. Those activities affected by the nonconforming work should be notified. The responsibility for review and authority for the disposition of nonconforming work should be defined in documented procedures. Disposition of nonconforming work can include reworking it to meet requirements, accepting it with or without repair, using it for alternative applications, or scrapping it. A determination to accept nonconforming work as is or with repair should have the concurrence of the engineer of record.

Disposition of nonconforming work should be documented. Reworked or repaired work should be reinspected in accordance with documented procedures.

2.2.12 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 element also includes implementing and recording changes in procedures resulting from corrective action.

Corrective action procedures should be established for:

a. Investigating the cause of nonconforming product and taking the corrective actions needed to prevent recurrence.
b. Analyzing processes to detect and eliminate potential causes of nonconforming product.
c. Initiating preventative actions to deal with problems to a level corresponding to the risks encountered.
d. Ensuring that corrective actions are taken and that they are effective.
e. Implementing and recording changes in procedures resulting from corrective action.

Comment:

Corrective action should be taken with respect to nonconforming work, and it should be proactive so as to eliminate potential problems which have not yet occurred.

2.2.13 Quality Records

Procedures should be established and maintained for quality records. These procedures should identify which records should be kept, responsibility for production and collection, and responsibility for indexing, filing, storage, maintenance, and disposition of quality records.

Quality records should be maintained to show achievement of quality objectives and appropriate functioning of the quality system. Supplier, contractor, and subcontractor quality records should be included where pertinent.

Quality records should be legible, and should specify the work involved. They should be kept in an environment to minimize deterioration and damage. Retention times and final disposition should be established and recorded.

Where specified by contract, quality records should be made available to the purchaser or purchaser's representative.

Following are examples of the types of quality records requiring control:

- o inspection reports
- o test data
- o qualification records
- o calibration records
- o nonconformances

- o corrective actions
- o audit reports

Comment:

A useful tool for keeping track of the QA records is the QA Records List. This is a list of every document generated as a result of implementing the quality program.

2.2.14 Quality Audits

> ***An internal audit should be established to ensure that the elements of the quality system are functioning as intended.***

Each audit should be scheduled. The frequency should depend upon the status and importance of the activity being audited. The audits and follow-up actions should be documented and conducted in accordance with documented procedures. The results of the audits should be presented to the personnel having responsibility in the area being audited. Responsible management personnel should take timely corrective action on the deficiencies found by the audit.

Comment:

The QA audit should be conducted by qualified quality personnel, in order to ensure that it provides substantive results. The QA audit is not the same as a financial audit.

2.2.15 Training

> ***The grantee should establish and maintain procedures for identifying the training needs and provide for the training of all personnel performing activities affecting quality.***

All personnel performing activities affecting quality should be qualified on the basis of appropriate education, training, and/or experience, as required. Appropriate records of training should be maintained.

Comment:

A training matrix can be used as a tool for determining which personnel require which training. The training matrix lists the relevant personnel within the agency or within project consultants and contractors versus various quality related procedures. Figure 2-1 is an example of a training matrix:

Figure 2-1

Training Matrix

	Procedure Number							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CEO	CR		RA					
Project Manager	CR	RA	RA	RA	RA	RA	CR	RA
Project Engineer	CR	RA	RA	RA	RA	RA	CR	
Resident Engineer	CR	CR	RA	RA				
Inspectors		CR		RA	RA			RA
QA Personnel	RA	RA	CR	RA	RA	RA	RA	RA

Key: CR is classroom
RA is "read and acknowledge"

2.3 Selection of Quality System Elements for Quality Programs

The ANSI/ASQC Q90 [Ref. 38] standard provides a list of selection factors to consider when determining which quality system elements should be included in a project quality program. Following are the factors as interpreted for an FTA capital construction project or equipment purchase.

a) *Design complexity*

This factor deals with the difficulty of the construction project or equipment design, if the project or equipment has yet to be designed.

b) *Design maturity*

This factor deals with the extent to which the total design is known and proven, either by performance testing or field experience.

c) *Production-process or construction complexity*

This factor deals with:

1) the availability of proven production or construction processes;
2) the need for development of new processes;
3) the number and variety of processes required; and
4) the impact of the process(es) on the performance of the equipment or service.

d) *Construction project or equipment characteristics*

This factor deals with the complexity of the construction project or equipment, the number of interrelated characteristics, and the criticality of each characteristic for performance.

e) *Project or service safety*

This factor deals with the risk of the occurrence of failure and the consequences of such failure.

f) *Economics*

This factor deals with the economic costs, to both supplier and purchaser, of the preceding factors weighed against costs due to nonconformities in the construction project or equipment.

Given the above factors, the PM should determine the appropriate level of a quality program for the project. Complex projects involving new rail construction, for example, may require the incorporation of all fifteen quality system elements in a quality program.

Simpler projects, where the design and construction methods are fairly standard, where the risk of safety related failures are low, and where project budgets are small may require a much less extensive quality program. Not only are fewer elements needed, but for those elements which are required, activities can be limited to those relating to final inspection and testing. In this later case, however, there is still the obligation to do whatever inspections and test are required to substantiate conformance with specified requirements.

Variations between the two extremes are appropriate for projects of moderate complexity. Table 2-1 suggests how quality elements might be selected for the two extremes.

Table 2-1

Checklist of Quality Elements for Capital Projects of Varying Complexity

Quality Program Elements	Full System for Complex Projects	Limited System for Simpler Projects
1. Management Responsibility	X	X
2. Documented Quality System	X	X
3. Design Control	X	---
4. Document Control	X	X
5. Purchasing	X	---
6. Product ID & Traceability	X	X
7. Process Control	X	---
8. Inspection & Testing	X	X
9. Inspectn, Meas., & Test Equipment	X	X
10. Inspection and Test Status	X	X
11. Nonconformance	X	X
12. Corrective Action	X	---
13. Quality Records	X	X
14. Quality Audits	X	___
15. Training	X	X

CHAPTER 3
ORGANIZATION OF A QUALITY SYSTEM

3.1 Grantee Organization and Responsibility

FTA grantees use many different organizational structures for carrying out capital projects. All work including design, procurement, construction management, and construction may be done in-house or by outside suppliers or contractors. The organization of a grantee quality system may also be structured in many ways, however, all of the applicable quality system elements should be incorporated into the activities of the organizational entities involved in the program. The measures instituted should give serious consideration to minimizing the disruption to continuing grantee operations.

3.1.1 General Principles

In Chapter 2, the quality element "Management Responsibility" states that a person should be designated as a representative of management who has the responsibility and authority to ensure that the management's quality policy is implemented and maintained. Those responsible for verifying that quality activities are performed in accordance with established requirements and procedures should be independent of those directly responsible for the work.

The fulfillment of management's responsibility suggests that:

- A quality policy should be adopted by the grantee's senior manager and accepted by all members of management.
- There should be a prevailing attitude that all members of the organization are responsible for the fulfillment of the quality policy, and management should look to all elements of the organization for assurance that quality is being attended to.

- There should be a person designated by and reporting to the senior manager to overview the established quality system and advise the manager of the effectiveness in meeting project quality objectives.

- Those responsible for ensuring quality should report one level higher than the activity with which they have oversight responsibility.

It is important to distinguish between responsibility for the quality policy, and responsibility for quality of a project or activity. Each person responsible for a project or activity is also responsible for the quality of that project or activity. On the other hand, the QA staffs are responsible for participating in the quality processes, and for ensuring that these processes are working. If the processes are working properly within a project, there is more certainty that the project quality objectives will be achieved.

The QA staff should be seen by the PM as part of the team. The QA staff and the QC activities should be seen as helpful in preventing errors which could lead to significant problems and increased cost. The organizational structure should reinforce the concept that the QA staff is part of the project team.

An appropriate approach to carrying out the "Management Responsibility" element is for the grantee to have a "Director of Quality Assurance" reporting to upper management. Where the QA role is focused on capital projects, the Director of Quality Assurance should report to the manager responsible for the implementation of the capital projects. The advantages of such a structure are:

- The responsible management for the Grantee can be confident that appropriate attention is being paid to quality and that FTA funds are being wisely used.

- Quality is highly visible within capital projects of the grantee.

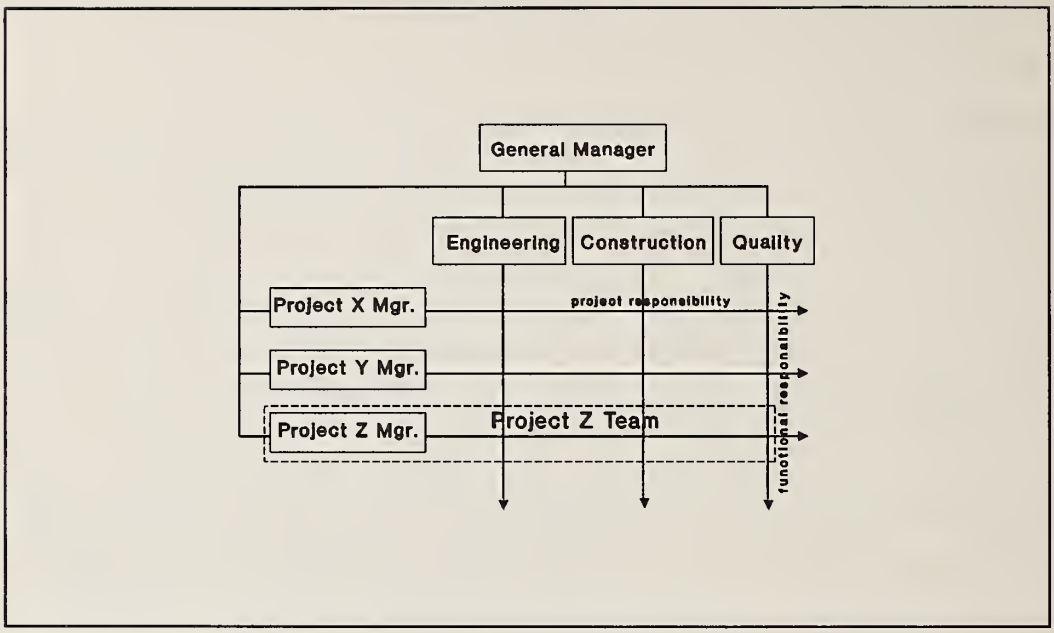
- QA activities are coordinated so that duplicate planning, training, and oversight activities are eliminated.

The Director of Quality Assurance should be responsible for verifying the implementation and maintenance of the grantee quality policy and detailed quality procedures. The Director of Quality Assurance should provide oversight of all quality activities, assistance to the PMs in the development of project Quality Plans, prevention and resolution of quality problems, oversight of contractor QA/QC programs, QA training programs, QA oversight, and QA audits.

As stated previously, FTA requires that major capital projects have a PMP which includes a Quality Plan for the project. Responsibility for quality within a capital project and for the Quality Plan should rest with the PM for that project. The PM should have access to QA and QC personnel to assist with project quality activities. A concerted effort to comply with quality requirements by those performing the work can significantly reduce the scope of a formal QA oversight activity.

The matrix organization for project management provides a mechanism for the PM to have access to QA staff assistance, and for the quality oversight to be provided at a higher management level. 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. The QA personnel work in partnership with representatives of engineering and construction on particular projects. This structure allows the QA representatives to be partners in the quality management system, rather than outsiders who are there to find fault.

Figure 3-1 - Matrix Organization



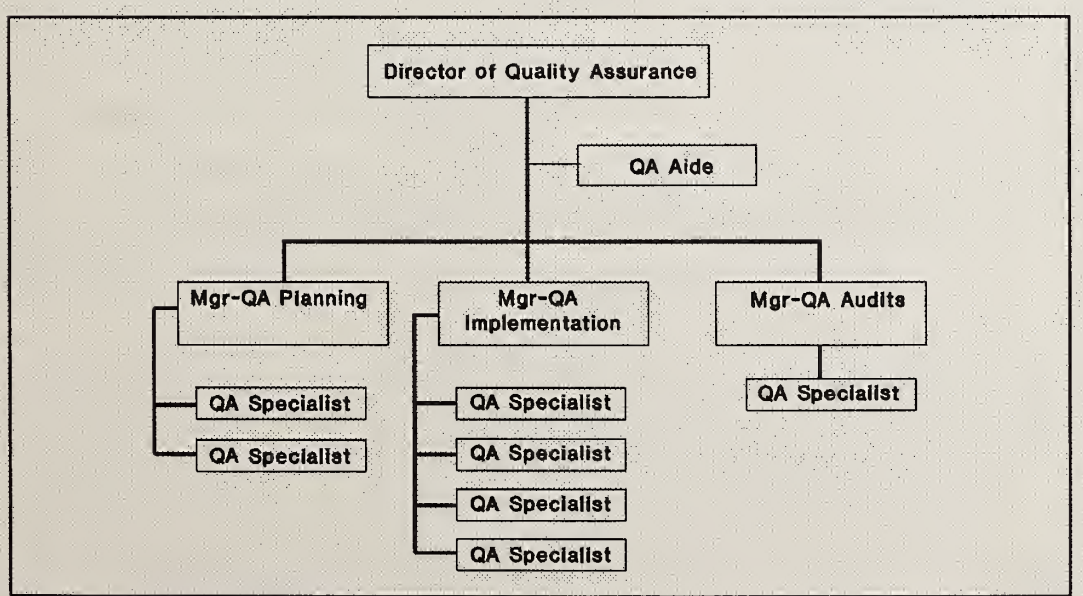
Case Study - The Long Island Railroad (LIRR)

The LIRR has been developing its QA program since early in 1987. At that time the LIRR's office of the Director of Audits conducted an initial review of the procedures and process controls at the Hillside Maintenance Complex construction site. The LIRR had contracted a construction management consultant (CMC) and the purpose of the review was to evaluate the CMC's performance.

The review found many deficiencies in the contractor's quality program. The absence of a formal quality program or organization within the LIRR was the reason these quality related problems were not identified until the review by the Director of Audits. Findings from the review, schedule delays, cost overruns, and PMOC recommendations led the LIRR to authorize the development of a quality program and organization. Although initially aimed at the problems at the Hillside Maintenance Complex, the program as implemented covers all LIRR capital projects and force account work.

The LIRR now has several years of experience with its QA program. The current quality organization at the LIRR is under the Director of Quality Assurance reporting to the President of the LIRR through his Chief of Staff. The Director of Quality Assurance has quality responsibilities for the entire railroad, including operations. Figure 3-2 shows the organization of the LIRR QA Department.

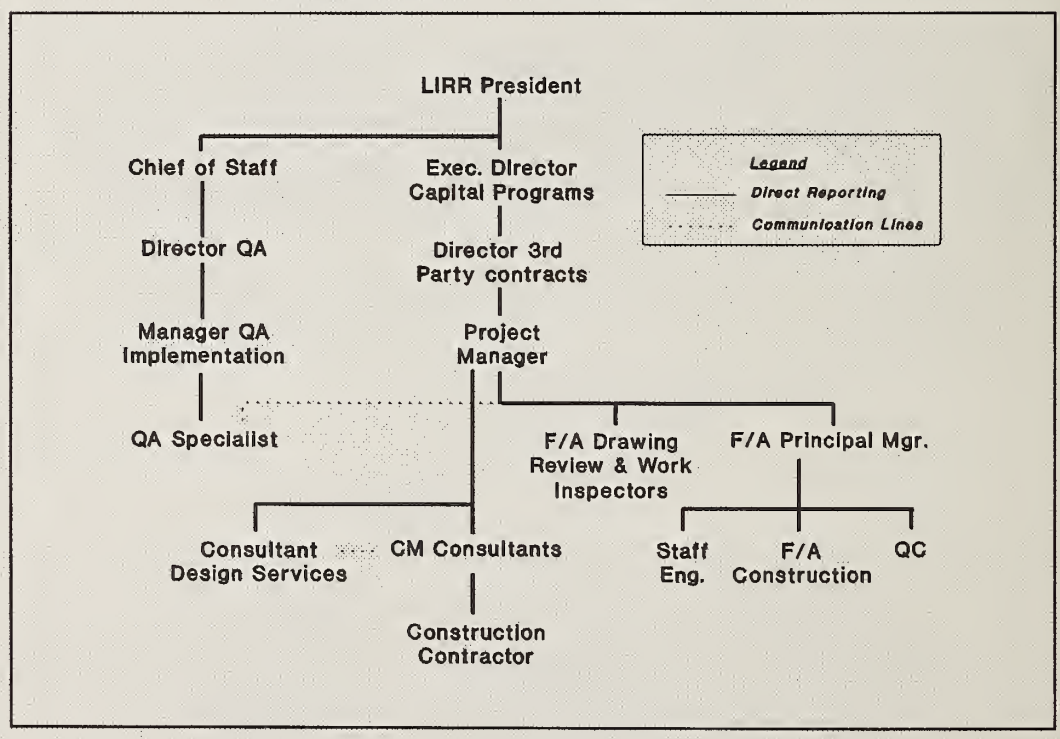
Figure 3-2 - Organization Chart for the LIRR QA Department



Project level QA/QC is the responsibility of the Project Manager (PM). The PM is responsible for project QA and has staff for performing drawing reviews and work inspections. The Director of Quality Assurance assigns a QA specialist for the project. The QA specialist assists the PM with QA problems, and provides general QA input.

Figure 3-3 shows a simplified organization chart for the LIRR Atlantic Avenue Viaduct Rehabilitation Project. Note that the Force Account (F/A) Principal Manager has his own quality control staff.

Figure 3-3 - Organization Chart for the LIRR Atlantic Avenue Viaduct Rehabilitation



Some grantees divide up the QA responsibilities and assign them to functional areas such as engineering, construction, or procurement. This approach recognizes the specialty skills which are appropriate for QA in these various areas. Indeed, in larger grantee organizations it makes sense to have functionally specific quality manuals. However, it is less desirable to split the QA organization because it results in multiple quality programs and procedures within the agency and a less visible program overall. Such a program can still provide adequate QA/QC at the project level, however.

There are situations where a grantee may not have a permanent QA staff. One such is where a grantee undertakes a one-time capital project where the quality function is a discrete activity developed solely as a part of the project. In general, a lack of a dedicated QA staff can cause a problem if the project faces budget or time pressures. A lack of a dedicated QA staff has often resulted in weakened quality programs.

3.1.2 Project Management Plan Guidelines

FTA requires that its grantees undertaking a major capital project must submit a PMP for FTA's review and approval, both initially, and as changes are made throughout the project. Although FTA has some discretion in determining which capital projects are considered major, they generally include projects like construction of a new fixed guideway segment, extension of an existing fixed guideway, or modernization of existing fixed guideway systems pursuant to a full funding contract. As part of the PMP, FTA requires that the grantee include QA and QC procedures and define QA and QC responsibility for construction, system installation, and integration of system components [Ref. 28].

While PMPs are required only for major capital projects, they are encouraged for all projects because they are a very useful project management tool. Similarly, significant benefits can be derived from a Quality Plan even where the project is not considered major.

The PMP should be produced at the end of the Project Planning phase or at the beginning of the Preliminary Engineering (PE) phase of the project. The timing is essential for the Quality Plan as well, since the requirements for QA/QC in design should be specified at the time of the design procurement. The PM's expectations for a project quality system must be made known in the procurement documents. These requirements should be a detailed extension of the PMP established QA/QC requirements.

The PMP should be updated as the project progresses through final design, procurement, construction, testing, and start-up. Likewise, the Quality Plan should be adjusted to reflect the organization and particular requirements to be instituted at each of these phases. Chapter 4 discusses the development of the Quality Plan for a project.

When a grantee has an existing quality policy and written procedures, development of a Quality Plan for a project can be done by adopting those procedures which are appropriate for the specific project or the project phase under consideration. Responsibility for preparing the plan could rest with the Director of QA or with QA/QC staff assigned to the PM. Ultimately, the PM must approve the QA/QC plan. The PM is ultimately responsible for the quality of the project.

3.2 Alternative Organizational Structures

Following is a discussion of alternative ways of organizing a quality system given different project organizations and objectives.

3.2.1 QA/QC Program with a Construction Management Consultant

One alternative for organizing a major capital project is to use a Construction Management Consultant (CMC) to manage outside construction contractors. This type of project management organization has been successful in implementing QA/QC programs.

There may be a number of reasons for the success of this approach. First, a project can be a discrete activity organized to minimize disruption to the grantee's established internal relationships. Second, many experienced CMCs have adopted QA programs and have considerable experience in applying such programs for design and construction projects.

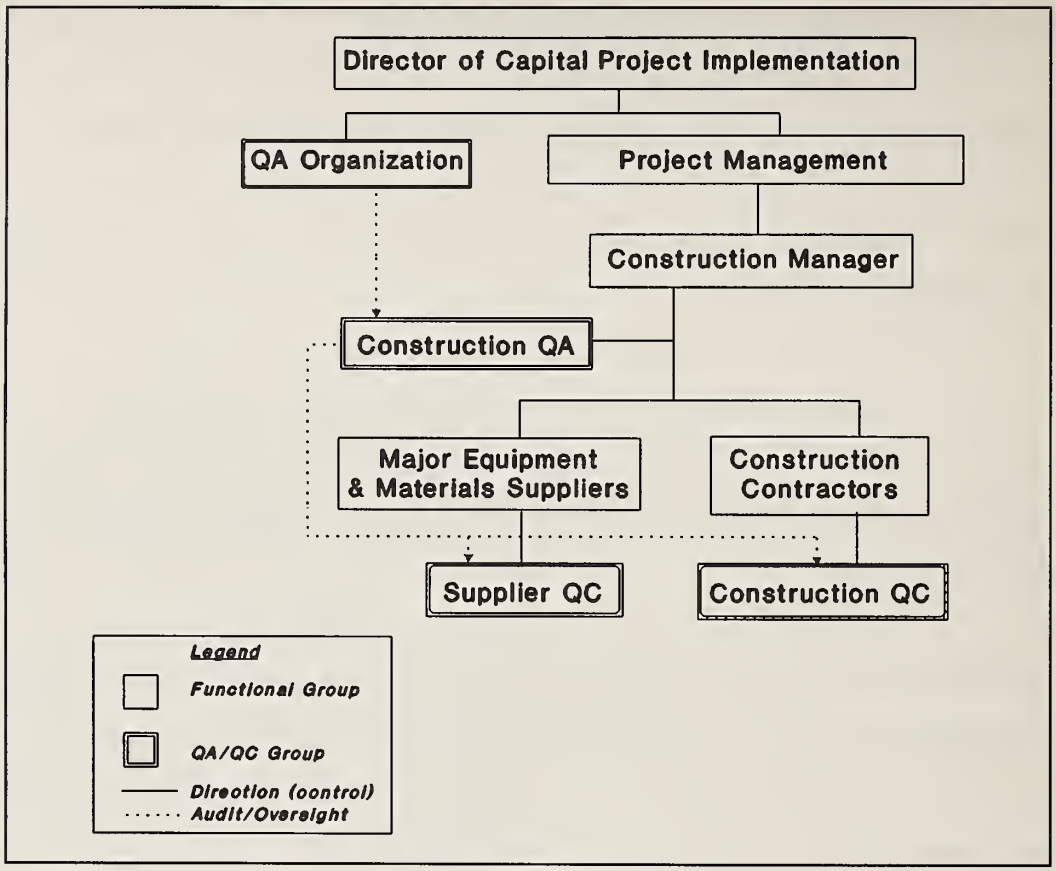
When a grantee uses a CMC to undertake the QA role for a project, the grantee still needs assurance that the project quality objectives are satisfied. The grantee cannot delegate this responsibility. Therefore, the grantee oversight of the quality process must be maintained to ensure that it functions effectively.

Figure 3-4 shows an organization chart for the project management and the quality organization for a project with a CMC. As can be seen from this figure, the construction contractor is responsible for QC. The CMC provides the QA, and the grantee provides QA oversight for the project.

In order for the structure shown in Figure 3-4 to be successful, all parties must understand their responsibilities and quality plan requirements from the beginning. The contract documents for the construction contractors must specify the role of the CMC in providing QA for the project as well as the contractor responsibility for QC. The construction contractor must provide the CMC with appropriate access for observation and inspection, and access to quality records. In most cases grantees have found it very difficult to achieve effective contractor quality programs when the CMC's QA role has not been adequately defined in the contract documents.

Likewise, the CMC must understand the grantee role in quality oversight of the project. That role needs to be spelled out in the request for qualifications and the contract document with the CMC to clearly indicate the approach the grantee will take to ensure the CMC quality system requirements are satisfied.

Figure 3-4 - Example of a Project Quality Organization with a Construction Management Consultant



3.2.2 QA/QC Program with In-House Construction Management

Another alternative for organizing a large capital construction project is to use internal staff for construction management. Construction is done either by outside construction contractors or by inside "force account" staff. Often this option follows the use of CMCs on long,

multi-stage projects. Agency staff assume more and more of the responsibilities of the CMC, and finally take over all construction management functions.

The grantee construction management should be responsible for QA for the project, and should have appropriate staff available for undertaking the QA role. The person designated to provide QA oversight for the project should verify to the grantee senior manager that the established quality system is being appropriately applied. This oversight activity is especially important where the project scope does not justify a separate QA staff for the project, and where the QA responsibilities are assumed by the PM/CMC staff. Without oversight, this latter arrangement often leads to a weakened QA program.

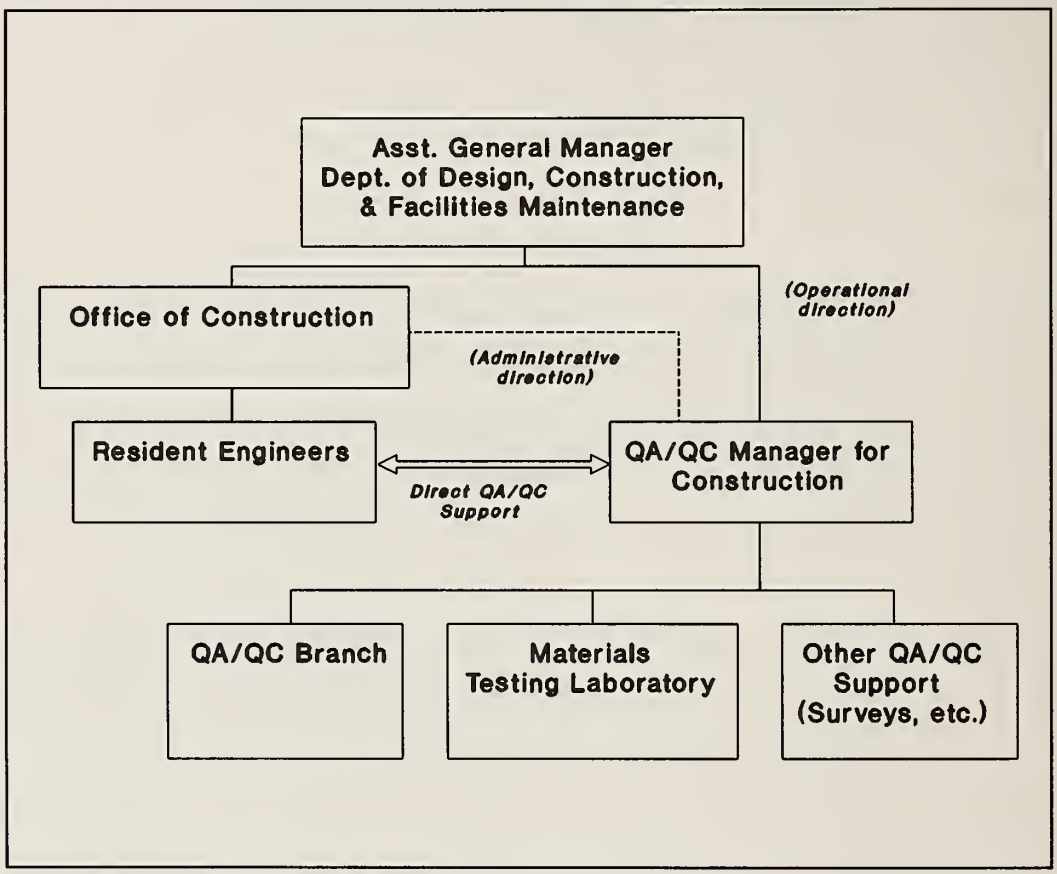
Typically, where there is an outside construction contractor, that contractor is responsible for the QC system to be applied for the work performed. Often the construction contractor has its own QA/QC program which can be utilized where acceptable to the grantee. An exception in transit construction projects occurs where the grantee or a third party takes responsibility for materials testing, thus assuming a QC activity.

A similar approach for quality should be followed where construction is performed by force-account staff. The internal construction manager should be responsible for undertaking the QA role, while the force account staff should be responsible for QC. There should also be a person designated to provide QA oversight to verify to the grantee senior manager that the established quality system is being appropriately applied. This later role is important, especially if the construction manager is not familiar with QA responsibilities and the quality system.

WMATA is an example of a grantee which evolved from using a CMC to doing its own construction management. WMATA employs outside construction contractors. WMATA has a QA/QC Manager for its Office of Construction. The QA/QC Manager has staff for providing QA/QC support to the Resident Engineers. It also has a materials testing laboratory which provides some QC for contractor work. Construction contractors are

responsible for QC, and WMATA has developed minimum specifications for the contractor QC program. Figure 3-5 shows the WMATA organization for construction projects.

Figure 3-5 - WMATA Organization for In-House Construction Management



3.2.3 QA/QC in Design

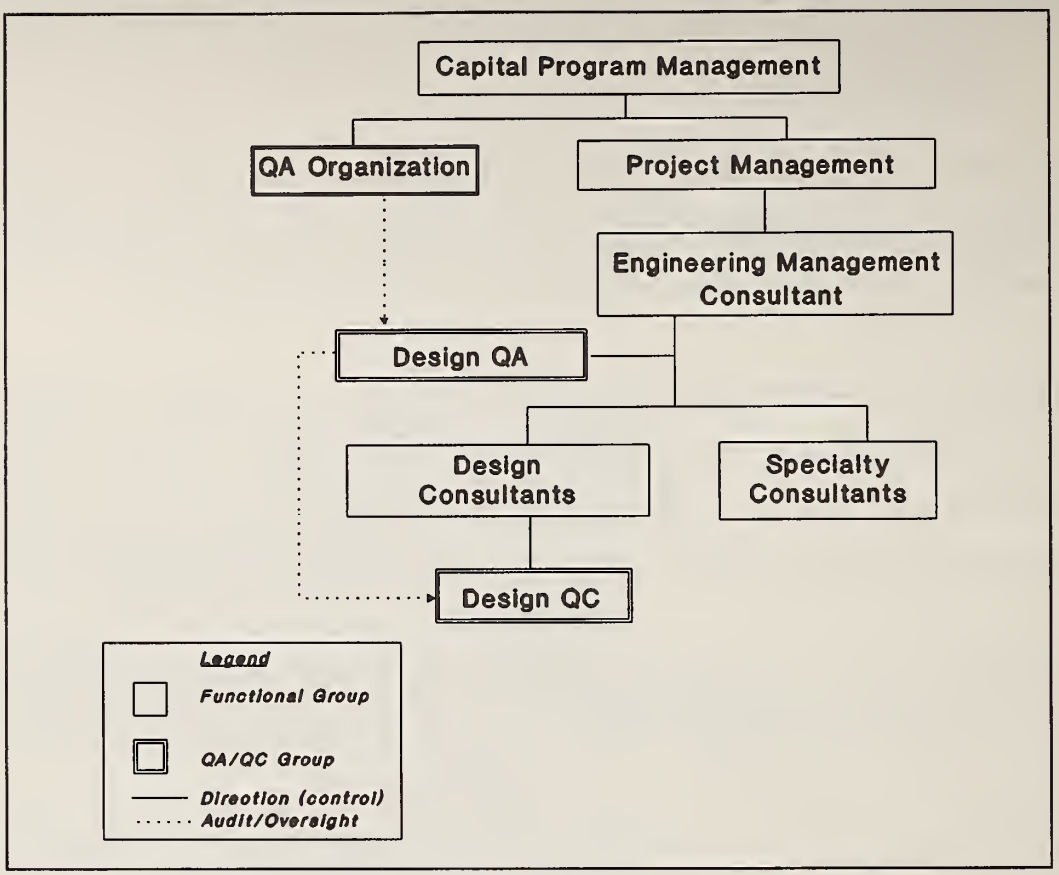
QA/QC in design is a very important part of a project related quality program. A study by the Construction Industry Institute (CII) [Ref 6] showed that design errors caused 79 percent of the rework in construction, whereas construction errors caused 17 percent.

As with construction, there are many different ways for a grantee to organize its design activities. The grantee may use a management contractor for design, and outside A&E firms to produce the design. The grantee may handle design management in-house and contract the design to an A&E firm. The grantee could handle both management and design in-house.

Quality programs in design can likewise vary to accommodate the management organization for design. Typically, the organization doing the design is responsible for QC for design.

The organization providing design management should be responsible for providing the QA system for design. Where an outside contractor is responsible for design management, any QA responsibilities should be specified early in the relationship between the grantee and the design management contractor. Likewise, the QA role of the design management contractor should be specified in the contract of the organization responsible for doing the design. The grantee needs to maintain an oversight role to acquire confidence that the quality system for design is achieving the project quality objectives. Figure 3-6 illustrates an organizational structure for QA in design using an outside design management contractor.

Figure 3-6 - QA/QC Organization for Design with a Design Management Contractor



Where the grantee retains responsibility for design management, the grantee PM should be responsible for establishing a design QA system.

Where the design effort remains entirely in-house, a two-tier organization for QA/QC is warranted. Those producing the design should be responsible for QC activities. The design management should be responsible for establishing a design QA activity for oversight of the design process. In this case, an independent QA audit might be conducted to ensure design management compliance to the design procedures.

3.2.4 QA/QC for Small Projects

Smaller grantees may not be able to justify a special QA/QC staff for a one-time project. Also, grantees may not be able to justify QA/QC staff for smaller projects such as bus storage and maintenance facilities. Nevertheless, each grantee still has the responsibility to ensure that FTA capital funds are wisely spent. The PM of a small project should develop a quality system for the project by determining which of the fifteen basic elements of a QA/QC program are applicable to the work being performed. Where the project is simple, where design and construction methods are standard, and where the risk of failure is low, the quality system might be focused on final testing and inspection activities (See Chapter 2, Section 2.3). Even so, many of the fifteen elements may be required to get to the final inspection and testing stage.

One approach for handling QA/QC activities on projects of limited scope is to make the construction contractor responsible for some QA and QC activities, and the grantee project management responsible for QA oversight activities. For example, the construction contractor could perform inspection and testing and provide the documentation thereof; document any design changes; inspect and track any purchased product; and document any nonconformance and corrective action. For a small project, the project management staff should undertake QA oversight activities such as witnessing testing, reviewing contractor documentation, and monitoring contractor compliance with its QA/QC program and other contract requirements. An option for providing QA oversight of both the project management and the construction contractor activities is to use an outside firm for this purpose.

Case History of a Small Project

A small rehabilitation project had many inter-disciplinary interfaces, and the project had to be performed while existing services were maintained. The owner knew the difficulties that the project would present and started thinking about ways to control cost, schedule, and quality during the planning phase of the project. Resources, including funding and manpower, were limited. The following actions were taken:

- The owner required the contractor to provide a QA/QC manual to cover the scope of the work.

- The owner required that the contractor provide QA/QC personnel.

- The owner required that all project work be identified on checklists that could

  a) be signed off by the contractor
  b) provide owner hold and witness points
  c) be signed off by QA/QC personnel

- The owner identified what records would be required to be turned over as a result of implementing the project quality plan.

Of the fifteen quality elements, portions of each (except for Quality Audits) were contained in the contractor's QA/QC program. The benefits that were realized as a result of these actions were:

- The contractor supplied the needed human resources.

- Every interface that the owner deemed critical was verified.

- Every document that the owner needed was retained.

- A system to identify, and rectify potential problems was established prior to the first problem becoming an issue.

3.2.5 QA/QC in Equipment Procurement

The purchase of major capital equipment by a grantee is another process where the application of the fifteen quality elements is appropriate. The grantee's quality system should provide for procedures for purchasing. The PM or project engineer in charge of the purchasing effort would be responsible for determining which quality elements and procedures should be applied to their project.

Alternatives for purchasing vary from requirements for the supplier to have a complete fifteen element QA/QC program to requirements for a program limited to final inspection and testing. In either case, the grantee will have to provide QA oversight to ensure that the supplier programs are consistent with the project quality objectives and effective in meeting grantee expectations. Chapter 2, Section 2.3 provides some guidance for the selection of quality elements that might be appropriate in a supplier quality program.

An adequate supplier QA/QC program is important, however, the responsibility for QA oversight is also critical. The role of QA oversight on complex procurement projects requires highly knowledgeable staff. Where such staff is not available, a grantee should consider hiring a consultant to assist in the QA oversight activity.

CHAPTER 4
DEVELOPING A PROJECT QUALITY PLAN

4.1 Goals and Objectives

The goal of a Quality Plan is to explicitly plan for the quality related activities needed to ensure that the project meets the requirements of the grantee and complies with regulatory requirements. The Quality Plan should be developed hand-in-hand with the PMP for the project. It is a living document in that it may need to be revised as the project progresses from the Project Planning Phase through Preliminary Engineering, Final Design, Construction/Procurement, and Testing and Start-up.

4.2 Responsibilities

The PM is responsible for the Quality Plan. Ultimately, the PM must determine which procedures should be applied to the project. Where there is a Director of Quality Assurance or equivalent position, that person should also have to accept the plan.

4.3 Approach

Where a grantee has detailed procedures for carrying out the elements of the quality policy, the development of a Quality Plan for a project is straight forward. The PM can adopt particular procedures as appropriate during the different project phases of Project Planning, PE and Final Design, Procurement/Construction, and Testing and Start-up. The Quality Plan should provide an overview of the entire quality program for the project, and should provide enough detail either through incorporation of or reference to written procedures.

Where written procedures have not been adopted by the grantee, they will have to be developed specifically for the Quality Plan. Thus, if a grantee expects to be involved in multiple capital projects using FTA funding, the grantee should consider the formal development of written procedures.

The Quality Plan should be written to provide project management with easy access to the quality requirements. When the plan references procedures or standards, those items should be readily available as part of the plan. References to unavailable sources should be avoided.

4.4 Technical Requirements During Each Project Phase

While it is possible that one Quality Plan could be written at the end of the Project Planning Phase of the project which is applicable throughout the project, the more likely situation is one where the Quality Plan evolves as the project progresses. This is so because the organizations may change and the level of quality assistance required by contractors can vary. Also the procedures, forms, reports, etc. initially proposed for a QA/QC program may not be used or are changed during the course of the project. These changes should be reflected in the Quality Plan if they improve the final documentation and quality of the work.

There are exceptions to the traditional phased approach to a project. In turnkey situations, one contractor could be responsible for several project phases. Therefore, the QA/QC program requirements should be completely specified at the time of the project bid and turnkey contractor selection.

The following sections describe the type of detail which is desirable in a Quality Plan during the relevant project phases. The description is for the desired detail for a complex project where all of the quality system elements should be included at some time during the project. Less detail may be appropriate for simpler projects (see Chapter 2, Section 2.3).

4.4.1 Project Planning

Project Planning can include the bus maintenance facility planning process; rail modernization planning; and the Alternatives Analysis (AA) process for major capital investments for which FTA has established detailed procedures. Responsibility for bus maintenance facility planning and rail modernization planning typically rests with the operating agency. For AA planning, the responsibility may be spread among several agencies. The lead agency need only have the charter, authority, and capability to perform the planning and receive the grants required to accomplish the AA.

For major capital projects, a PMP should be produced at the end of the Project Planning Phase. The PMP should be developed by the project owner, which may be different from the organization doing the Project Plan. Generally, the PMP must be submitted during the project grant review process and as part of FTA's grant application review. A Quality Plan is required as part of the PMP.

At this early phase, much is still unknown about the project. The participants may not be known, so that the Quality Plan cannot name organizations and persons. Timing, budgets, construction techniques, and so forth have yet to be decided. Initially, therefore, the Quality Plan should consist of a general description of the fifteen basic quality elements as applicable to the grantee and the project. The quality policy and appropriate existing procedures should be included in the Quality Plan.

Development of the Quality Plan is important at this phase to set an overall expectation and direction for quality for the project, and to clearly spell out quality requirements for procurement of the design consultants. Table 4-1 indicates the quality system elements for which design related detail might be appropriate at this initial phase.

There may not be a quality requirement for submittal of a Quality Plan for projects which are not major, and which do not have a PMP requirement. However, the development of a

Quality Plan can be beneficial for project management and project control purposes. Again, at this phase, the major planning effort should be focused on the quality requirements for the design activity.

4.4.2 Preliminary Engineering and Final Design

The Preliminary Engineering (PE) Phase is initiated at the conclusion of Project Planning. In PE the design is developed enough to provide a more accurate estimate of project costs and impacts. The resultant technical and financial information forms the basis for subsequent funding and implementation decisions. During PE the merits of all sound configurations and designs are investigated. In addition, environmental requirements are completed, including preparation of a Final Environmental Impact Statement, and in some cases, a supplemental Draft Environmental Impact Statement.

The Final Design Phase is the last project development phase prior to construction. During this phase, the design consultant and/or in-house design staff prepares the plans, specifications, and bid documents required for awarding the individual facility construction and equipment fabrication/installation contracts.

Table 4-1 - Details of the Quality Plan at the Project Planning Phase

Quality Program Elements	Detail Required
1. Management Responsibility	Describe the quality responsibilities of the project team, and the persons / organization responsible for quality for the grantee. Identify specific personnel where possible.
2. Documented Quality System	Incorporate by reference any written procedures for quality applicable to the project. Design related procedures are particularly relevant. Note that applicable existing procedures can be referenced for any of the following elements.
3. Design Control	Specify requirements for review & sign-off for design from departments such as Construction and Operations, and other relevant agencies. Specify required design reviews during the PE and Final Design Phase. Specify any contract quality requirements for PE or Final Design consultants. Describe the procedures to be followed for design changes, including signoff and documentation.
4. Document Control	A procedure for the control of project documents should be specified. This procedure may be modified as contractors and consultants join the project.
5. Purchasing	Describe procedures to obtain a list of qualified contractors for the design service. Provide a statement of general requirements, including quality requirements, and any past demonstrated capability and performance requirements. Describe the process to ensure that purchasing documents are reviewed and approved by a designated authority prior to release.
11. Nonconformance	Procedures for handling non-conforming work should be described, and potential design contractors should be made aware of these procedures.
12. Corrective Action	Procedures for handling corrective action should be described, and potential design contractors should be made aware of these procedures.
13. Quality Records	Procedures should be specified for establishing and maintaining quality records. Requirements for contractors and subcontractors should be specified, and made part of bid specifications and contracts.
14. Quality Audits	An internal audit should be described with the initial focus on the design process at this phase in the project.
15. Training	Specify any training required for personnel.

Management of PE and Final Design is the responsibility of the grantee who must ensure that knowledgeable personnel are available to perform the required services.

Two basic alternatives exist for organizing the PE effort. The chosen alternative may be continued into Final Design, or a different alternative can be established at that point. The two alternatives are 1) the grantee staff performs all design, or 2) consultants have the primary responsibility for design. There are also organizational alternatives in-between these extremes which mix the use of grantee staff and consultant staff. For larger projects, either the owner or a general design consultant can supervise and manage the work of firms retained to design sections of the project.

As design consultants are chosen and the design management organization is put into place, the PMP should be updated to reflect these actions. The Quality Plan should updated to reflect each new organization of quality activity, and it should be updated to reflect more closely the planned quality activities during the Final Design Phase. The plan should begin to answer more specifically the questions of who is responsible, and when in time actions should occur.

More important, the Quality Plan should be updated to reflect the quality requirements for the next phase in the process. Since an important product of the design phase is construction contract documents for construction contractors, decisions about quality requirements for construction and manufacturing need to be planned and included in the contract documents. Table 4-2 indicates the detailed descriptions which might be appropriate at this phase in the project Quality Plan.

Table 4-2 - Details of the Quality Plan at the PE/Final Design Phase

Quality Program Elements	Detail Required
1. Management Responsibility	Describe the quality responsibilities of the project team, and the persons / organization responsible for quality for the grantee and for the design consultant. Identify specific personnel where possible.
2. Documented Quality System	Incorporate by reference any written procedures for quality applicable to the project. Construction and/or equipment manufacturing related procedures are particularly relevant.
3. Design Control	Describe the procedures to be followed for design or specification changes, or waivers of requirements during construction. Signoff of the responsible design consultant is desirable as well as signoff by those originally responsible for the design approvals. Requirements for "as-built" documents should be stated.
4. Document Control	A procedure for the control of project documents should be described. This procedure should incorporate the design consultants for the project. This procedure may be modified as construction contractors and construction management consultants join the project.
5. Purchasing	Describe procedures to obtain a list of qualified contractors for the desired service. Provide a statement of general requirements, including quality requirements, and any past demonstrated capability and performance requirements. Describe the process to ensure that purchasing documents are reviewed and approved by a designated authority prior to release.
6. Product ID & Traceability	Describe requirements for product identification and traceability to be placed in contract documents, where appropriate, for equipment manufacturers or others supplying products for the project. Describe where these requirements are appropriate.
7. Process Control	Describe requirements for process control and procedures for special processes to be placed in contract documents, where appropriate, for contractors. Describe where these requirements are appropriate.
8. Inspection & Testing	Describe requirements for inspection and testing to be placed in contract documents, where appropriate, for contractors. Inspection and testing can include in-process inspection and testing, final inspection and testing, and receiving inspection. Specifications should indicate the types of tests required and the standards to be met. Describe where these requirements are appropriate.
9. Inspectn, Meas., & Test Equipment	Describe requirements for calibration and maintenance of inspection, measuring, and test equipment to be placed in contract documents, where appropriate, for contractors. Describe where these requirements are appropriate.
10. Inspection and Test Status	Describe requirements to be placed in contract documents, where appropriate, for contractors to identify the inspection and test status of work during production and installation. Describe where these requirements are appropriate.

Quality Program Elements	Detail Required
11. Nonconformance	Grantee procedures for handling nonconforming work should be described, and these procedures should be included in contract documents to clarify future expectations.
12. Corrective Action	Grantee procedures for corrective action should be described, and these procedures should be included in contract documents to clarify future expectations.
13. Quality Records	Procedures should be specified for establishing and maintaining quality records. Requirements for contractors and subcontractors should be specified, and made part of contract documents.
14. Quality Audits	An internal quality audit system should be planned and implemented for the design activities during PE and Final Design. Requirements for contractors to cooperate with quality audits should be stated, and included where appropriate, in contract documents.
15. Training	Specify any training required for personnel.

4.4.3 Construction and Equipment Procurement

During the Construction and Equipment Procurement Phase, suppliers, contractors, and/or agency force account employees construct the fixed facilities, fabricate/install equipment, and integrate them into a functioning system. During this phase the Quality Plan should be developed in sufficient detail to guide the grantee in appropriate QA, QC, and quality oversight procedures.

During this phase the first task is to procure the required contractors. These include the CMC, the construction contractors, and/or the equipment manufacturers. Where procurement regulations allow, contractors should be prequalified. Evidence of an acceptable quality program should be part of the prequalification process.

Where the specifications for the various contracted project tasks require the contractor to assume responsibilities for specific quality activities, the contractor should prepare written documentation of its quality program. This program should be reviewed and approved for

adequacy by the Grantee's Project Manager and the Director of Quality Assurance, or equivalent position. Where a contractor has a proven track record with respect to quality and a complete and satisfactory quality program, the contract documents need only specify the quality program criteria and require the contractor to follow its own program. More specifics and details may be required where the contractor does not have a proven track record.

Key quality elements which need to be specified in detail in the Quality Plan and, where appropriate, in contract documents, are procedures for nonconformance and corrective action during manufacturing and/or construction. In particular, the process for stopping work should be spelled out. Persons authorized to issue stop-work orders, procedures for doing so, approvals required, and restrictions need to be clearly understood by the contractors as well as the grantee. The grantee's role in providing quality oversight for the project should be described, and any audit activities should be planned. Table 4-3 indicates the type of information that would be useful at this phase.

Table 4-3 - Details of the Quality Plan at the Construction/Procurement Phase

Quality Program Elements	Detail Required
1. Management Responsibility	Describe the quality responsibilities of the grantee project team, and the persons / organization responsible for quality for the grantee and for construction management consultants, construction contractors, and equipment manufacturing contractors. Identify specific personnel where possible. Identify grantee staff responsible for quality oversight activities.
2. Documented Quality System	Incorporate by reference any written procedures for Quality Plan applicable to the project. Construction and/or equipment manufacturing related procedures are particularly relevant.
3. Design Control	Describe the procedures to be followed for design or specification changes, or waivers of requirements during construction. Signoff of the responsible design consultant is desirable as well as signoff by those originally responsible for the design approvals. Requirements for "as-built" documents should be stated.
4. Document Control	A procedure for the control of project documents should be described as it relates to the various construction contractors and consultants for the project. Contractor obligations should be specified and should be included in the contract documents.
5. Purchasing	Describe requirements for purchasing control to be placed upon construction contractors or equipment manufacturing contractors for the project. Describe purchasing control procedures to be followed by the grantee.
6. Product ID & Traceability	Describe requirements for product identification and traceability which should be included, where appropriate, in contract documents.
7. Process Control	Describe requirements for process control, and procedures for special processes which should be included, where appropriate, in contract documents. These procedures should specify any sequencing of work requirements.
8. Inspection & Testing	Describe requirements for inspection and testing for each contract, as appropriate. Inspection and testing can include in-process inspection and testing, final inspection and testing, and receiving inspection. State the types of tests required and the standards to be met.
9. Inspectn, Meas., & Test Equipment	Describe requirements, as appropriate, for calibration and maintenance of inspection, measuring, and test equipment for each contract.
10. Inspection and Test Status	Describe requirements, as appropriate, for contractors to identify the inspection and test status of work during production and installation.
11. Nonconformance	Grantee procedures for handling nonconforming work should be specified in detail. All contractors should be made aware of the procedures. Procedures include defining responsibilities, stating conditions which would cause work to stop, and providing documentation. Specify the requirements for the contractor to have its own procedures.

Quality Program Elements	Detail Required
12. Corrective	Procedures for taking corrective action should be specified in detail. Each contractor should be made aware of the procedures. Specify any requirements for the contractor to have its own procedures.
13. Quality Records	Procedures should be specified for establishing and maintaining quality records. Requirements for contractors and subcontractors should be specified, and made part of the contract documents.
14. Quality Audits	An internal audit should be planned and implemented for the construction and equipment manufacturing activities.
15. Training	Specify any training required for personnel.

4.4.4 Testing and Start-up

The Testing and Start-up Phase is the bridge between the Construction and Equipment Procurement Phase and the beginning of revenue service. The purpose of this phase is to accept the newly constructed or modernized facility, and/ or the newly procured equipment. This phase also includes integration testing of operating system prior to beginning or resuming revenue service. This phase overlaps with Construction and Equipment Procurement Phase, since some testing is performed in accordance with contract requirements during the earlier phase.

The Quality Plan should be modified prior to the beginning of the Testing and Start-up Phase to include detailed procedures for those tests required for the transfer of facilities and equipment from the constructing organization to the operating organization. Although contractually required testing will have been done as part of Construction and Equipment Procurement, other testing is required for the owner/operating organization to accept the facilities and equipment. Acceptance criteria, however, must be specified at the end of the Final Design Phase, and included in the construction contract documents.

Management of the testing program at this point is the responsibility of the owner. Testing should be managed by a test management team as part of the project staff. A test engineer should manage the program with assistance from consultants and agency staff, as appropriate.

An exception to this situation would be when the contractor constructing the new system will also be responsible for operating the system for a period of time. In this case, all system integration testing would be performed as part of the contract with the constructing/operating organization. The tests must therefore be detailed in the Final Design Phase.

Preparation for revenue service start-up also includes the training of personnel to operate and maintain the facilities. Prior to service start-up the grantee should simulate service to test whether all system elements are functional and perform as designed. Start-up operations should verify the competence of the personnel and ensure a smooth and safe transition into operations.

The Quality Plan for the project should also reflect the need for ongoing maintenance contracts, as well as grantee/operator actions required to keep the contractual warranties in force. Table 4-4 shows the Details to be included in the Quality Plan at the beginning of the Testing and Start-up Phase.

Table 4-4 - Details of the Quality Plan at the Testing and Start-up Phase

Quality Program Elements	Detail Required
1. Management Responsibility	Describe the quality responsibilities of the project team, and the persons / organization responsible for quality for the grantee and for construction management consultants, construction contractors, and equipment manufacturing contractors. Identify specific personnel responsible for acceptance, demonstration, and integration testing. Identify grantee test engineer responsible for the testing program.
2. Documented Quality System	Incorporate by reference any written procedures for Quality Plan applicable to the project. Testing related procedures are particularly relevant.
3. Design Control	Describe the procedures to be followed for fixing problems which are uncovered during final testing. Configuration management practices should be followed.
4. Document Control	A procedure for the control of documentation from the testing program should be described.
5. Purchasing	In addition to the requirements for testing of materials defined in the purchasing contract documents, the Quality Plan should specify random testing by the grantee of products for which fabricators submit material certificates or certificates of compliance. Testing should also be conducted when the validity of the materials/products or documentation are questionable.
6. Product ID & Traceability	Describe the requirements for product identification and traceability for products and materials turned over to the owner at the project conclusion.
7. Process Control	Describe plans for maintenance of the facility and equipment, especially as required for warranty purposes.
8. Inspection & Testing	Describe plans for acceptance testing, demonstration testing, and integration testing of the system and equipment. Acceptance tests verify that performance of all delivered equipment is in conformance with specifications. Demonstration tests demonstrate the reliability of the system equipment. System integration testing demonstrates the ability of various subsystems and facilities to work together as a system and for the new or modernized system to function with an existing system. Tests which affect system safety should be reviewed independently in a safety review to ensure that potential hazards are identified and resolved.
9. Inspectn, Meas., & Test Equipment	Describe requirements, as appropriate, for calibration and maintenance of inspection, measuring, and test equipment as required for final testing.
10. Inspection and Test Status	Describe requirements, as appropriate, for the owner to identify the inspection and test status of work during final testing.
11. Nonconformance	Procedures for handling nonconforming work should be maintained during final testing.
12. Corrective	Procedures for taking corrective action should be maintained during final testing.

Quality Program Elements	Detail Required
13. Quality Records	Procedures should be specified for maintaining quality records for a specified period after project completion.
14. Quality Audits	An final audit should be planned and implemented to ensure that project quality records are complete and in satisfactory condition.
15. Training	Specify training required for grantee operating and maintenance personnel to ensure a smooth transition to operations.

Given the existence of a detailed project Quality Plan, and given that the plan is carefully executed each of the project phases from Project Planning through Testing and Start-up, revenue service should meet the quality specifications of the grantee, and provide excellent service. This, ultimately, is the objective of the quality program.

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APPENDIX A - SELECTIONS FROM TRANSIT QUALITY PROGRAMS

Although each organization should tailor their quality program to fit their own structure and requirements, examples of policies, procedures, and formats from other transit capital programs are helpful to use as starting points. This appendix presents selections from a number of transit quality programs in use around the United States. The selections may use different titles than the quality elements in these guidelines and their content may be slightly different. Nevertheless, these selections largely represent the elements suggested in this guidance.

Attached are the following:

Part 1: *Design Control*

From the RCC Quality Assurance Program Manual.

Part 2: *Document Control*

From the RCC Quality Assurance Program Manual.

Part 3: *Purchasing*

A section entitled "Procurement Control" from the RCC Quality Assurance Program Manual.

Part 4: *Process Control*

Sections entitled "Special Processes" and "Bridge Steel Fabrication" from the SWTP Construction Management Plan, Quality Assurance/Quality Control Procedures.

Part 5: *Inspection and Testing*

Sections entitled "Site Receiving Inspection, Preservation, and Storage," and "Inspection and Test Activities" from the SWTP Construction Management Plan, Quality Assurance/Quality Control Procedures.

Part 6: *Inspection, Measuring, and Test Equipment*

A section entitled "Calibration of Measurement and Test Equipment" from the SWTP Construction Management Plan, Quality Assurance/Quality Control Procedures.

Part 7: *Nonconformance and Corrective Action*

A section entitled "Control of Discrepant Items and Corrective Action" from the RCC.

A form and instructions for reporting nonconformances from the LIRR.

Part 8: *Quality Records*

From the RCC Quality Assurance Program Manual.

Part 9: *Quality Audits*

From the RCC Quality Assurance Program Manual.

Part 1: Design Control

From the RCC Quality Assurance Program Manual

Design Control

1.0 Purpose

To describe the requirements for the control of design activities associated with RCC projects.

2.0 Scope

These requirements apply to the activities of defining, controlling, and verifying the design of structures, systems and equipment, for RCC projects.

3.0 Policy

3.1 All design consultants, sub-consultants, and design contractors are required to maintain a Design Procedures Manual. Design Procedures Manuals will include controls for design quality acceptable to RCC.

3.2 Design activity will be controlled in accordance with applicable regulatory requirements and the design basis shall be identified and translated into specifications and drawings. Quality standards and appropriate quality criteria will be specified in the design documents. Quality levels will be established that are consistent with the criticality of the system or subsystem element to safety, reliability, maintainability, and performance.

4.0 Procedures

4.1 Design Procedures Manuals and instructions are to be submitted to RCC for review and acceptance prior to start of work on an RCC project.

4.2 Design Procedure Manuals will include as a minimum:

- Design bases with the scope of work, the technical requirements, applicable codes and standards, design criteria, performance characteristics, conceptual design, and other design parameters delineated in such a way as to facilitate the design process.
- Design documents, specifications, test/analysis reports, or other documents used to specify the design will be identified using a Project Numbering System prepared in accordance with applicable standards or practices, and accounted for in a log or register. Design documents will be subject to a review/check process, and coordinated with interfacing design disciplines or groups.
- Design documents are to be controlled to assure the use of approved documents, maintained in discipline/project files, and distributed in accordance with a master distribution list prepared for the project and approved by RCC.
- Design documents will provide for identification of items important to quality and safety by providing traceability of the item through part numbers, heat/log numbers, serial numbers, or other means.
- Design documents will provide identification of acceptance criteria.

4.3 Design reviews will be performed to determine that the design bases have been accurately expressed and to verify the constructability of the design.

- Calculations will be checked by other design personnel.
- Design reviews are to consider that appropriate quality levels and standards have been specified for the intended use, and that parts, materials, equipment, and processes specified are appropriate to the application.
- Design reviews will include appropriate means of verifying design such as modeling, design analysis, qualification testing, evaluation of historical data and simulation.

4.4 Design reviews, checking, alternate calculations, performance tests, or other means used to verify the design prior to issue will be performed by personnel other than those who originated the design but with qualifications at least equal to those of the originators. Review personnel may be supervisors who were not actually involved in the design.

4.5 Design changes (revisions) will be subject to checking, coordination, and design review to the same level as the original design. Only design change documents approved approved by a Change Control Board will be issued for use on projects. Superseded design documents will be marked and retained for information only.

4.6 RCC Quality Assurance will audit the design process to verify that quality considerations have been included during design development.

- The design will be reviewed to assure inclusion of inspection and test attributes.
- The Design Review package will be checked for adequacy and completeness.
- The Design Review documentation will be checked for content, procedure and approval for bid consideration.

Part 2: Document Control

From the RCC Quality Assurance Program Manual.

Document Control

1.0 Purpose

To establish requirements for the systematic control of documents for RCC projects.

2.0 Scope

These requirements for document control apply to the systematic and controlled release, reproduction, distribution, maintenance, retention and disposition of RCC and consultant/contractor prepared documents.

3.0 Policy

Project documents such as correspondence, specifications, instructions, submittals, procedures, forms, and drawings will be controlled in accordance with established Configuration Management Control procedures.

4.0 Procedures

4.1 Each project will identify the organization responsible for establishing and maintaining the system for control of project documents.

4.2 Detailed document control procedures will be developed and implemented for each project.

4.3 At the completion of the project, document control files will be turned over to RCC in accordance with the required RCC format.

4.4 Document control procedures, including subsequent revisions, will be reviewed and approved by the cognizant Quality Assurance organization prior to implementation.

4.5 The organization responsible for control of project documents will:

- Establish document control procedures.
- Establish a filing system which assures that documents are safely secured, maintained, and readily retrievable for use by project or system personnel.
- Prepare appropriate indices for documents received or collected for systematic filing.
- Establish necessary logs, registers, transmittals, and acknowledgements to determine and record status of documents in accordance with specific project or system procedures and instructions.
- Implement controls for reproduction of "Controlled Documents" to minimize potential use of obsolete documents.
- Maintain a log or matrix to document and record historical procedures in a chronological order. Approved original procedures shall be retained for reference.

4.6 RCC Engineering and Construction Management personnel will identify documents to be controlled.

Part 3: Purchasing

A section entitled "Procurement Control"
from the RCC Quality Assurance Program Manual.

Procurement Control

1.0 Purpose

To outline the requirements for Quality Assurance/Quality Control measures for procurement in order to verify that requirements established by design and contract are included in the appropriate documents throughout the procurement cycle.

2.0 Scope

The requirements of this section apply to all procurement for RCC projects.

3.0 Policy

3.1 The policy of RCC is to control procured material, equipment and/or services, with sufficient specification detail to meet design and contract requirements.

3.2 Contractors/suppliers will submit procedures for such control to RCC or designee for review and acceptance prior to release of purchase documents to vendors.

4.0 Procedures

4.1 PROCUREMENT DOCUMENTS - Applicable design bases and Quality Assurance program requirements will be included or referenced in documents used for procurement of materials, parts, equipment or services.

- Quality program requirements applicable to lower-tier contractors or suppliers are to be specified.
- Procurement documents for items and services will include a statement of the scope of work to be performed by the supplier.
- Documents which are used to procure materials are to be reviewed by Quality personnel to verify that data necessary to assure quality are included or referenced in such documents. Revisions to these documents are subject to the same review as the original.

4.2 SOURCE SELECTION - Contractors/suppliers will be evaluated prior to bid award to determine their capability to meet procurement requirements.

- Based upon positive results of the evaluation vendors/suppliers will be considered as qualified to meet procurement quality requirements.

4.3 SOURCE SURVEILLANCE/INSPECTION - When source surveillance or inspection is necessary, requirements will be established and reviewed with the supplier. Names, locations, and inspection requirements for subtier suppliers will be obtained during this time.

- Initial surveillance/inspection will include a review of fabrication drawings to verify compliance with codes, specifications and purchase order requirements. Material

will be reviewed and verified as required. Documented evidence of all surveillance/inspection is to be maintained in quality files.

4.4 When required, a resident inspector will be assigned for the procurement. Resident inspections will be performed and documented on a daily basis or as the process occurs at the supplier location. This type of inspection may be performed by RCC designated personnel.

5.0 Attachments

5.1 Exhibit 4-1 - Quality Assurance System Evaluation

Exhibit 4-2 - Evaluation Summary Sheet

EXAMPLE

RCC

Quality Assurance System Evaluation

Project: _____

Contract Number: _____ Title: _____

Company: _____

Address: _____ Telephone: _____

Company Personnel Contacted:

Name	Title
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Total Inspection Personnel: _____ Date: _____

Total Production Personnel: _____ Survey By: _____

Ratio: _____ _____

Total QA/QC Personnel: _____ System does/does not meet

Total Facility Personnel: _____ requirements. _____

EXHIBIT 4-1

EVALUATION SUMMARY

Contractor: _____

Contract No: _____

SECT	SYSTEM ELEMENT	Program		Operative		REMARKS
		YES	NO	YES	NO	
I	ORGANIZATION					
II	QUALITY ASSURANCE PROGRAM					
III	DESIGN CONTROL					
IV	PROCUREMENT CONTROL					
V	CONSTRUCTION/INSTALLATION CONTROL					
VI	INSTRUCTIONS, PROCEDURES, AND DRAWINGS					
VII	DOCUMENT CONTROL					
VIII	CONTROL OF MATERIALS, EQUIPMENT, PARTS, COMPONENTS AND SERVICES					
IX	CONTROL OF SPECIAL PROCESSES					
X	INSPECTION AND TEST					
XI	CONTROL OF MEASURING AND TEST EQUIPMENT					
XII	CONTROL OF DEFICIENT ITEMS					
XIII	QUALITY RECORDS					
XIV	AUDITS					

EVALUATOR'S COMMENTS

_____

_____

_____

_____

_____

_____

_____

_____

EVALUATOR'S SIGNATURE AND DATE

EXHIBIT 4-2

Part 4: Process Control

Sections entitled "Special Processes" and
"Bridge Steel Fabrication"
from the SWTP Construction Management Plan,
Quality Assurance/Quality Control Procedures.

The following is from the Quality Control section of the SWTP Construction Management Plan, Chapter 4, Quality Assurance/Quality Control Procedures. Because these procedures are project related, they may be more specific than would be required for an agency-wide QA/QC program. They are included here to give an example of the kind of detail which can be useful for Process Control at the project level.

Some definitions are required for abbreviations used in the text:

AISC American Institute of Steel Construction

CM Construction Manager

CTA Chicago Transit Authority

DFIR Daily Fabrication Inspection Report

DPW City of Chicago, Department of Public Works; the agency responsible for design, procurement, construction, and operation of the Southwest Transit system.

NDE Nondestructive examination

QCM Quality Control Manager

QCS Quality Control Specialist

SWTG Southwest Transit Group (the Joint Venture of the Ralph M. Parsons Company; De Leuw, Cather & Company, William E. Brazley and Associates, Ltd.; C.F. Moore Construction Company; and Dubin, Dubin and Moutoussamy doing business as SWTG, engaged by DPW as Construction Manager for the Southwest Transit Project.)

SPECIAL PROCESSES (WELDING, HEAT TREATMENT, AND NDE)

Manufacture/fabrication contractor's QC programs shall include use of procedures for control of special processes, as appropriate, and as defined in the purchase order or other contractual documents. Manufacture/fabrication contractors are responsible for performing welding, NDE, and heat treatment activities in accordance with approved procedures, and for performing tests and inspections shown in approved inspection plans. They may elect to have tests/inspections performed by an approved independent laboratory or inspection agency.

A. Review and Approval

The QCM is responsible for having the procedures reviewed and approved by qualified technical and QA/QC personnel within the CM's organization. Inspectors are responsible for verification that manufacture/fabrication contractors use approved procedures and qualified personnel to accomplish welding, NDE, and heat treatment work.

B. Qualification of Procedures/Personnel

Manufacture/fabrication contractors shall conduct procedure and personnel qualification tests and notify the inspector to obtain the required witnessing by SWTG or the DPW, as appropriate. Inspector shall verify that the manufacture/fabrication contractor is maintaining welder qualification and welder performance status and that only properly qualified welders are used.

C. Control of Welding Materials

Inspectors shall ensure that manufacture/fabrication contractor store and handle welding filler metals in accordance with manufacturer's recommendations. Inspectors shall also ensure that only filler metals authorized for use by approved welding procedures are used.

D. Welding Inspection

Contractors shall control and inspect their welding activities in accordance with the approved welding procedures and the requirements of the approved source inspection plan. Inspectors or QCS's shall, if radiographs are required, ensure welds are radiographed after heat treatment and spot check "in process" welding operations. This may include visual examination of final welds. For critical welds, it may also include checking fit-up and verification that proper filler metal and pre-heats are used.

E. Nondestructive Testing (NDE)

Qualified Inspectors shall verify that contractors perform NDE in accordance with approved procedures using properly qualified personnel, and that NDE reports are traceable to the applicable weld.

F. Heat Treatment

Inspectors shall review and approve time versus temperature curves after heat treatment, and when required witness and approve hardness testing of heat treated welds or any other heat treatment required.

BRIDGE STEEL FABRICATION

Steel fabrication subcontracts for bridges and viaduct sections require special witnessing by QC personnel. The following sequence is required by the DPW to verify the quality of the finished product.

A. Shop drawings are to be reviewed and accepted by the Manager of Construction Services and stamped copies given to the Inspector.

B. The Fabricator's QC programs will be reviewed for adequacy by the QCM.

C. The Fabricator shall submit the AISC (American Institute of Steel Construction) certification along with all relevant data to the QCM for review and acceptance.

D. Materials certifications shall be reviewed and accepted at the Fabricator's Facility by the SWTG QC Inspector. Acceptance shall be noted by the SWTG QC Inspector's signature or stamp on the material certification. These same documents shall be submitted in the final documentation package from the Contractor.

E. Burning, cutting and drilling shall be inspected and included in the Daily Fabrication Inspection Report (DFIR), SWTG Form 233, by the SWTG QC Inspector as time and discretion dictate.

F. All Fracture Critical welding shall be witnessed by an SWTG QC Inspector. This activity shall be recorded on the welding checklist and included in the DFIR.

G. Non-fracture critical welding will be audited to assure that approved fabricator procedures are being followed. A minimum of 20% will be observed.

H. When weld repairs are necessary, the Contractor shall submit the repair procedures to the SWTG QC Manager for review and approval prior to initiating the repair. All weld repairs, both critical and non-critical categories (AREA 15.1.14.9.4), will be witnessed by an SWTG QC Inspector.

I. Qualifications of personnel performing radiographic inspection will be reviewed by SWTG QC personnel. Test personnel performance will be verified by audit. Double films will be made for all radiographs and one set forwarded to the SWTG QC Manager for review and concurrence with the interpretation of the SWTG testing laboratory.

J. All ultrasonic testing will be witnessed and reported on the appropriate checklist and DFIR by an SWTG QC Inspector who will participate in selecting the areas for testing. Should any doubts be generated by testing or interpretation, an SWTG Testing Laboratory will be brought in to do further ultrasonic testing.

K. All magnetic particle testing will be reported on the appropriate checklist and DFIR by a SWTG QC Inspector.

L. Shop bolted fasteners shall be tightened to a gap of 0.005" or less (expressed as a "nil gap") on the Direct Tension Indicators and inspected by a SWTG QC Inspector. Upon achieving a record of satisfactory compliance the sample size of the inspection shall be reduced to random sampling.

M. Laydown assembly of the structural members will be witnessed by the SWTG QC Inspector and all activities, especially repairs or modifications, are to be documented on the DFIR.

N. Sandblasting shall be a hold point for SWTG inspection., All members shall be visually inspected by the SWTG QC Inspector prior to applying the prime coat.

O. All shop coats of paint will be inspected completely by the SWTG QC Inspector prior to the application of the next coat.

P. Erection of the finished structural members will be witnessed by an SWTG Structural Inspector, who is to verity that the erection is performed in accordance with the approved erection plan and that headline, bracing and field adjustments are not detrimental to the structure.

Q. Field bolting and painting will be subject to the regular field inspection practices as covered in the Chapter 9, Inspector's Guidelines. Direct Tension Indicators shall be closed to a gap of 0.005" or less on all bolted connections as per the latest manufacturer's recommendations.

R. Shop and field welding procedures will be approved by the Supervising Consultant or by a qualified SWTG welding engineer.

Should an occasional conflict of activities be encountered where two activities are happening simultaneously with only one person to witness the following priorities shall prevail:

1. Fracture Critical Welding
2. Fracture Critical Weld Repair
3. Ultrasonic testing
4. Field laydown
5. Inspection after sandblast/prior to painting
6. Paint inspections
7. Radiographic testing review/audit
8. Magnetic Particle testing review/audit
9. Other inspection

The following SWTG 233 series of forms and checklists, listed below, are to be utilized by QC personnel involved in the Bridge Steel Fabricator Quality Control Programs.

FORMS

Number	Title	Referenced
SWTG 094B	Inspection Plan	7.1.A
SWTG 231	QC Inspection Report	7.3.C
SWTG 233	Structural Steel Daily Fabrication Inspection Report	7.7
SWTG 233A	Materials Checklist	7.7
SWTG 233B	Burning Checklist	7.7
SWTG 233C	Welding Checklist	7.7
SWTG 233D	Bolted Connections Checklist	7.7
SWTG 233E	Sandblasting and Painting Checklist	7.7
SWTG 233F	Radiograph Test Checklist	7.7
SWTG 233G	Ultrasonic Test Checklist	7.7
SWTG 233H	Magnetic Particle Test Checklist	7.7

SWTG FORM 94B - INSPECTION PLAN

****SOUTHWEST TRANSIT GROUP

PROCEDURE NO	PAGE OF
REVISION NO	DATE
APPROVAL	DATE

INSPECTION PLAN

ITEM _____

CODE _____

LEGEND
- C RTD
- W WITNESS/HOLD POINT
- I INSPECT/RANDOM SPECIFIED
- RA REVIEW DOCUMENT REPORT AND ACCEPT

ITEM	DESCRIPTION OF INSPECTION	REF	MFR/ CONTR	SWTG	CTA	DPW

SWTG 094B 0388

SWTG FORM 231 - QC INSPECTION REPORT

====SOUTHWEST TRANSIT GROUP

MRR NO.
O & D NO.

QC INSPECTION REPORT

CONTRACT # _____ CONTRACTOR/P.O. #/REVISION _____ PAGE ___ OF ___

☐ VENDOR ☐ SUBVENDOR	LOCATION	CONTACT	TELEPHONE NO. ( )
MATERIAL OR EQUIPMENT DESCRIPTION			ITEM NUMBER(S)

DRAWINGS AND SPECIFICATIONS USED FOR INSPECTION: _____

SUMMARY OF INSPECTION RESULTS

INCLUDE MINOR DEVIATIONS WHICH WERE IDENTIFIED AND CORRECTED & IF MAJOR ACTION REQUIRED:

SKETCH

NONCONFORMANCES OUTSTANDING ☐ YES ☐ NO | NCR NUMBERS _____

DATE PREPARED | SIGNATURE OF QC INSPECTOR

SWTG-231 0388

STRUCTURAL STEEL
DAILY FABRICATION INSPECTION REPORT

Contract: SW- _____ Fabricator: _____

Unit Description: _____

The following inspection checklists are attached:

--- Materials	--- Sandblasting & Painting
--- Burning	--- Radiographic Test
--- Welding	--- Ultrasonic Test
--- Bolted Connections	--- Magnetic Particle Test

Summary of shop activities witnessed:

Summary of inspection activities performed:

Problems identified and/or resolved:

Witnessed by _____ Date _____ Page 1 of ____

SWTG FORM 233A - MATERIALS CHECKLIST

SWTG Contract # _____ Fabricator _____
Girder Ident # _____ Location _____
Type of Fabrication _____ Date _____
Contract Specification _____ Drawing # _____

Materials

		Yes	No
1.	U.S. made certification received?		
2.	List the fabricator's suppliers_____ _____		
3.	Are they mills or warehouses? _____ _____		
4.	Are material handling and traceability procedures in place?		
5.	Are they being enforced?		
6.	Are all mill certs available and in acceptable condition?		
7.	Are materials for different projects segregated?		
8.	Are raw materials or finished products held in secure or bonded areas?		
9.	Have fasterners and miscellaneous metals been procured and stored?		
10.	Are material sizes per shop drawings?		

Remarks (explain any "No" above):

Witness _____ Page ___ of ___

SWTG FORM 233B - BURNING CHECKLIST

SWTG Contract # _____ Fabricator _____
Girder Ident # _____ Location _____
Type of Fabrication _____ Date _____
Contract Specification _____ Drawing # _____

Burning

Yes No

Flange plate: _____ Top _____ Bottom
Type Steel _____
Edge Cut Square
Edge Gouged
Heat No. Marked on plates _____
_____

Web plate:
Type Steel _____
Thickness _____
Width _____
Length _____
Camber _____
Edge cut square
Heat No. marked on plates _____
_____

General Steel Condition: _____ Good _____ Poor
Explain _____
_____
_____
_____

Number of pieces inspected _____

Number of pieces on order _____

Remarks:

Witness _____ Page ___ of ___

SWTG FORM 233C - WELDING CHECKLIST

SWTG Contract # _____ Fabricator _____
Girder Ident # _____ Location _____
Type of Fabrication _____ Date _____
Contract Specification _____ Drawing # _____

Welding

Type of weld:
_____ Butt Grove _____ Tack
_____ Tee Grove _____ Full Penetration
_____ Fillet

If Repair:
(see AREA 15.1.14.9.4.)
_____ Critical
_____ Non-critical

	Yes	No
Material: Type _____ Thickness _____ FCM?		
Heat Number(s) _____		
Approved Weld Procedure Number _____		
Welding Procedure posted/in use?		
Welder/Tacker Qualified?		
Welder Name & Symbol _____		
Flux - as listed on weld procedure?		
Welding Machine - as listed on weld procedure?		
Weld Preparation - geometry and fitup checked by Contractor's QC?		
Electrode - as listed on weld procedure?		
Root treatment per weld procedure?		
Preheat and interpass temperatures per weld procedure?		
Temperature within 3" of weld _____F		
Post Heat Temperature _____F		
Back Gouging Required?		
Consumable Storage System:		
Clean _____ Electrodes Dry _____ Flux Temperature _____F		
Weld Profile Satisfactory?		
If UNSAT explain _____ undercut _____ over/underfill		

Remarks:

Witness _____ Page ___ of ___

SWTG FORM 233D - BOLTED CONNECTIONS CHECKLIST

SWTG Contract # _____ Fabricator _____
Girder Ident # _____ Location _____
Type of Fabrication _____ Date _____
Contract Specification _____ Drawing # _____

Bolted Connections

	Yes	No
Web Stiffener Assembly:		
Material types: _____		
Surface free of rust and scale		
Holes template drilled		
Holes round		
Holes clean and free of burrs		
Holes properly located		
Bolts: Heat/Lot number _____		
Diameter _____		
Length _____		
Grade _____		
Galvanized		
MFG. domestic		
Washers: Flatwasher Grade ____		
O. D. _____		
Galvanized		
MFG. domestic		
Direct tension indicators:		
Heat/Lot number _____		
I. D. _____		
Thickness _____		
Galvanized _____		
MFG. domestic		
Nuts: Heat/Lot number _____		
I. D. _____		
MFG. domestic _____		
Grade _____		
Type _____		
Lubricated _____		
Stiffeners contacting flanges +0 -1/16		
All bolt holes filled		
All assemblies complete		
All bolts tight, DTI gap less than 0.005"		

Remarks:

Witness _____ Page ___ of ___

SWTG FORM 233E - SANDBLASTING AND PAINTING CHECKLIST

SWTG Contract # _____ Fabricator _____
Girder Ident # _____ Location _____
Type of Fabrication _____ Date _____
Contract Specification _____ Drawing # _____

Sandblasting & Painting

Sandblasting Spec requirements for grit blast SSPC SP10

		Yes	No
1.	All areas cleaned equally?		
2.	Fillet and Stiffener areas clean?		
3.	Is steel in sound condition?		
	(Scabs, Tears, Lap Marks Rolling Flaws)		
4.	Are defects in steel notable?		

Remarks (explain any "No" above):

Painting (Prime Coat)

		Yes	No
1.	Are paint manufacturer's Certifications available?		
2.	Coating Thickness DFT?		
3.	Sags or Runs in Painted Surface?		
4.	Blistering or Bubbles in Paint?		
5.	Temperature above 40 F?		
6.	Paint Coat dry?		

Remarks (explain any "No" above):

Witness _____ Page ___ of ___

SWTG FORM 233F - RADIOGRAPH TEST CHECKLIST

SWTG Contract # _____ Fabricator _____
Girder Ident # _____ Location _____
Type of Fabrication _____ Date _____
Contract Specification _____ Drawing # _____

Radiograph Test

Requirement: 100% of all Butt welds shall be Radiographed.

Type of Material _____ Film

Piece Mark _____ Size _____

Material Thickness _____ Brand _____

Distance from source to material _____ Type _____

Exposure time _____

Shims
Front _____ Back _____

Cassettes
Double Load _____
Single Load _____

Technician, certification and date _____

Remarks:

Witness _____ Page ___ of ___

SWTG FORM 233G - ULTRASONIC TEST CHECKLIST

SWTG Contract # _____ Fabricator _____
Girder Ident # _____ Location _____
Type of Fabrication _____ Date _____
Contract Specification _____ Dwg # _____

Ultrasonic Test

Required test level 10% of weld length. of all Tee Welds.

Weld Description: Reference Standards:

Material _____ Calibration Date _____

Type of Joint _____ IIW Block _____Yes _____No(explain)

Thickness of Material _____ Horizontal Reference Line:

Surface Condition _____ 40% Full Screen _____Yes ____No(explain)

	Top Qtr.	Middlehalf	Bottom Qtr.
Transducer angle			
Frequency	MHz	MHz	MHz
Crystal Size			

Scan Pattern:

AWS _____Yes _____No(explain)

Test Results: Accepted _____ Rejected _____

Remarks:

Witness _____ Page _____ of _____

SWTG FORM 233H - MAGNETIC PARTICLE TEST CHECKLIST

SWTG Contract # _____ Fabricator _____
Girder Ident # _____ Location _____
Type of Fabrication _____ Date _____
Contract Specification _____ Dwg # _____

Magnetic Particle Test

Method of Inspection: _____Yoke _____Prod

Type of Magnetizing Current: _____AC _____DC

Inspector _____ Qualification _____

Remarks:

Witness _____ Page _____ of _____

Part 5: Inspection and Testing

Sections entitled "Site Receiving Inspection, Preservation, and Storage," and "Inspection and Test Activities" from the SWTP Construction Management Plan, Quality Assurance/Quality Control Procedures.

The following is from the Quality Control section of the SWTP Construction Management Plan, Chapter 4, Quality Assurance/Quality Control Procedures. Because these procedures are project related, they may be more specific than would be required for an agency-wide QA/QC program. They are included here to give an example of the kind of detail which can be useful for Inspection and Testing at the project level.

Some definitions are required for abbreviations used in the text:

CM	Construction Manager
CMTR	Certified Materials Test Reports
CTA	Chicago Transit Authority
DFIR	Daily Fabrication Inspection Report
DPW	City of Chicago, Department of Public Works; the agency responsible for design, procurement, construction, and operation of the Southwest Transit system.
MRR	Material Receiving Report
NDE	Nondestructive examination
OS&D	Overage and Shortage or Damage Report
QCM	Quality Control Manager
QCS	Quality Control Specialist
RE	Resident Engineer
RTD	Routed - Paperwork attached to an article to be inspected at various locations.
SWTG	Southwest Transit Group (the Joint Venture of the Ralph M. Parsons Company; De Leuw, Cather & Company, William E. Brazley and Associates, Ltd.; C.F. Moore Construction Company; and Dubin, Dubin and Moutoussamy doing business as SWTG, engaged by DPW as Construction Manager for the Southwest Transit Project.)

SITE RECEIVING INSPECTION, PRESERVATION, AND STORAGE

Receiving inspection preservation and storage of SWTG or DPW procured equipment and materials is mandatory. In addition, RE Inspectors or QCS will spot check contractor-furnished material or equipment for conformance to requirements.

RECEIVING INSPECTION

(A) Responsibilities

Inspectors on the various RE's staff shall be responsible for receiving inspection of materials and equipment delivered to the site, or requesting QCS support. Inspectors shall:

- Physically examine materials and equipment and their documentation to verify compliance with project requirements. Certified materials test reports (CMTR) not reviewed by construction management Inspectors at the source will be reviewed at the site.

- If materials/equipment are DPW-furnished, the Inspector at the direction of the RE, will coordinate with the installation contractor, so a joint receiving inspection can be conducted. If an installation contract has not been awarded, the Inspectors shall perform a receiving inspection and seek guidance from the RE on storage. Procedures for accountability of material and equipment will be provided in the Property Manifest.

(B) Procedure

The Inspector shall document material receiving inspection activities. The Inspector should focus attention on purchase orders, marking or tagging, CMTR, quantity verification, and physical damage. If the Inspector determines assistance is required to accomplish the inspection, he shall obtain this assistance through the RE.

(C) Documentation

Inspector shall record results of the inspection on a Material Receiving Report (MRR), SWTG Form 107, and, if necessary, shall complete an Overage and Shortage or Damage (OS&D) Report, SWTG Forms 182A and 182B. These forms are further described in Project Controls Procedure No. PC-8B.

The RE shall maintain a document file for all items pertaining to his contracts. The QCM shall maintain a master file of documents for all items received on the Southwest Transit Project.

(D) Disposition of Open Items

The RE shall track any open items identified in the receiving inspection. When the item is closed, a copy of the disposition will be forwarded to the QCM. The QCM shall maintain a status log showing the disposition of inspection items and their subsequent release for use on the site by the RE's.

PRESERVATION AND STORAGE

(A) Protection of Material

Inspectors shall verify that materials/equipment are protected from deterioration in accordance with manufacturer's recommendation. In addition, Inspectors will ensure that items are properly identified, handled, stored, and safeguarded.

(B) Reports

Inspector's daily reports shall document the status of compliance, and that necessary corrective action was taken on nonconforming items.

INSPECTION AND TEST ACTIVITIES

Inspectors shall conduct inspections and tests as delineated in approved Inspection and test plans and inspection checklists for Systems Installation and Facility Construction Contracts. All requirements for frequency of tests and acceptance/rejection criteria, as stated in the plans and

specifications, shall be followed. To the extent possible, qualified laboratories under contract to the DPW or previously used successfully by the DPW, will be selected by the SWTG QC staff. If necessary, other qualified independent laboratories will be selected, with DPW concurrence, for use on the project.

The procedures to be followed for welding, NDE, and heat treatment are described in Section 7 herein and in the CM Plan, Chapter 9, Inspector Guidelines. They will be followed when welding, NDE, and heat treatment are performed on site. Assistance from the QCM and staff shall be used to review welding, NDE, or any other special processes. In addition to the requirements specified in this Manual, Inspectors shall meet RE Manual, Construction Operations Manual, and Inspector Guideline requirements, to the extent they are applicable, in performing inspection and test activities.

Site Construction Quality Control Inspectors shall, as a minimum:

(1) Be knowledgeable of Plans and Specification requirements for the particular contract.

(2) Check documentation for material and equipment received at the site, to verify required tests were acceptable. Material and equipment shall be examined for damage and for conformance to specifications.

(3) Accomplish the inspections included in the approved inspection and test plans and inspection checklists.

(4) Monitor the activities and witness contractually mandated tests performed by others.

(5) Accomplish systems tests on specific procurement and installation contracts, to verify conditions prior to the start of work by an interfacing contractor.

(6) Accomplish system tests to verify that all subsystems are property integrated and perform as required.

(7) Coordinate the site activities of Procurement/Furnish and Install Contractors and any independent laboratories hired for the specific contract.

SWTG FORM 107 - MATERIAL RECEIVING REPORT (MRR)

MATERIAL RECEIVING REPORT

MRR NO.

JOB NUMBER _____ CLIENT _____ LOCATION _____

REQN. NO.	P.O. NO.	VENDOR'S NAME AND LOCATION	
SHIPPER'S NAME AND LOCATION		CARRIER PRO. NO.	SHIPPER'S NO.
RECEIVING DATE	CHECKED BY	CAR NO.	FREIGHT BILL AMOUNT $ ☐ PREPAID ☐ COLLECT
CONDITION AS RECEIVED ☐ GOOD ☐ DAMAGED ☐ SHORT OS & D NO. FOR:		STORAGE IDENTIFICATION	P.O. COMPLETE ☐ YES ☐ NO

P.O. ITEM NO.	QUANTITY RECEIVED	DESCRIPTION

PREPARED BY	SIGNATURE	DATE	MRR NO.

SWTG-107 0388

SHEET ____ OF ____

SOUTHWEST TRANSIT GROUP

OS&D REPORT (PART I)

JOB LOCATION _____ SHIPPER _____

VENDOR _____ MRR NO. _____ DATE REC'D _____

SHIPPING POINT _____ CAR NO. _____

CARRIER _____ F/B NO. _____

P.O ITEM NO.	QTY.	UNIT	SIZE	DESCRIPTION OF ITEM	DAMAGE	UNIT COST	TOTAL
					TOTAL COST		$

HOW NOTICABLE IS DAMAGE? ☐OBVIOUS(1) ☐CONCEALED(2)

WHERE DID DAMAGE OCCUR? ☐AT FACTORY ☐IN TRANSIT ☐IN PCI HANDLING

IS MANUFACTURER'S GUARANTEE AFFECTED? ☐ YES ☐NO ☐DONT KNOW

CAN DAMAGE BE REPAIRED? ☐YES ☐NO ☐ DON'T KNOW

CAN DAMAGE BE REPAIRED BY FIELD? ☐YES ☐NO

IS MATERIAL REQUIRED TO REPAIR ? ☐YES ☐NO

IF YES, WHERE WILL REPLACEMENT MATERIAL BE PURCHASED? ☐FIELD ☐HOME OFFICE

MUST REPAIR BE MADE IMMEDIATELY TO MAINTAIN CONSTRUCTION SCHEDULE? ☐YES ☐NO

IF REPAIR IS NOT URGENT, BY WHAT DATE MUST IT BE COMPLETED? _____

WHAT ARE ESTIMATED DIRECT COSTS FOR REPAIR? MATERIAL $_____ LABOR $_____

WAS SUPPLIER CONTACTED? ☐YES ☐NO

IF YES, IDENTIFY CONTACT. NAME _____ TITLE _____ LOCATION _____

METHOD OF CONTACT: ☐PHONE ☐WIRE ☐LETTER

NAME OF SUPPLIER _____ DATE _____

WAS CARRIER CONTACTED? ☐YES ☐NO

IF YES, IDENTIFY CONTACT. NAME _____ TITLE _____ LOCATION _____

METHOD OF CONTACT: ☐PHONE ☐WIRE ☐LETTER DATE _____

NAME OF CARRIER: _____

WAS PACKAGE BROKEN? ☐YES ☐NO

TERMS. ☐PREPAID ☐COLLECT AMOUNT $ _____

WAS PACKING LIST INCLUDED WITH SHIPMENT? ☐YES ☐NO

OTHER COMMENTS _____

PREPARED BY _____ APPROVED _____

INSTRUCTIONS:

(1) If damage is obvious at time of delivery, the freight bill shall be so noted and signed by Carrier. Include the signed freight bill with this report. Arrange for carrier to perform an inspection of damaged material. A completed carrier inspection report must be prepared immediately, signed by carrier's agent, and attached to this report.

(2) If damage is concealed, notify carrier immediately after unpacking and arrange for carrier to perform an inspection of damaged material. A completed carrier inspection report must be prepared immediately, signed by carrier's agent, and attached to this report.

(3) Attach to this report photographs of damaged materials.

(4) Do not proceed with repairs until authorized by Home Office.

SWTG-182A 0388

SOUTHWEST TRANSIT GROUP

OS&D REPORT (PART II) (DAMAGES ONLY)

P.O.	REV	CONTRACT	SUS	REQ	REV

RTD REFERENCE	

O	S	&	D	–				

DATE _____

JOS LOCATION _____

VENDOR _____ SHIPPER _____

SHIPPING POINT _____ MRR NO _____ DATE RECD _____

CARRIER _____ CAR NO. _____ F/B NO. _____

PO ITEM	QUANTITY ORD	SHIPPED	REC'D	DIFF	✓	MATERIAL	P	UNIT PRICE	TOTAL
								$	$
						TOTAL VALUE			$

TYPE OF CONTAINER _____ WAS CONTAINER PACKED TO CAPACITY? _____

KIND OF PACKING MATERIAL USED _____ THOROUGHLY SEARCHED? _____

OVERAGE OR SHORTAGE DETERMINED BY CHECK AGAINST P.O. _____ F.B. _____ P.L. _____ ERECTION _____ HANDLING _____

SUPPLIER CONTACTED: YES _____ NO _____ DATE _____ NAME _____ TITLE _____ LOCATION _____

CARRIER CONTACTED: YES _____ NO _____ DATE _____ NAME _____ TITLE _____ LOCATION _____

IF YES, CONTACTED BY PHONE: _____ WIRE _____ LETTER _____ PACKING LIST RECEIVED: YES _____ NO _____ WAS CONTAINER BROKEN: YES _____ NO _____

SHORTAGE — MUST REPLACEMENT BE MADE IMMEDIATELY TO MAINTAIN CONSTRUCTION SCHEDULE? YES _____ NO _____ IF REPLACEMENT NOT URGENT MUST BE AT JOBSITE BY WHAT DATE? _____

OVERAGE — FIELD RECOMMENDS: RETURNING TO SUPPLIER _____ RETAINING FOR FIELD USE _____

ADDITIONAL NOTES:
1. IF SHORTAGE WAS IN PACKING INDICATE ALL PACKING LIST DIFFERENCES ON THIS FORM.
2. IF SHORTAGE WAS IN SHIPPING INDICATE ALL FREIGHT BILL DIFFERENCES ON THIS FORM AND ON THE FREIGHT BILL. THE FREIGHT BILL MUST BE SIGNED BY THE CARRIER. INCLUDE THIS SIGNED FREIGHT BILL WITH THIS REPORT
3. DO NOT RETURN OVERAGES TO VENDOR UNTIL AUTHORIZED BY HOME OFFICE.

NOTE: REPORT DAMAGES ON PART II OF OS&D FORM

I CERTIFY THE ABOVE REPORT TO BE TRUE AND IN ACCORDANCE WITH THE CONDITION OF GOODS UPON RECEIPT.

✓=1 - OVERAGE
2 - SHORTAGE
3 - SUBSTITUTION
4 - UNSATISFACTORY
5 - FACTORY MISFABRICATION

PREPARED BY: _____

(SIGN NAME IN FULL) (MATERIALS MANAGER)

SWTG-182B 0388

SWTG FORM 094A - INSPECTION PLAN

****SOUTHWEST TRANSIT GROUP

PROCEDURE NO.	PAGE OF
REVISION NO.	DATE
APPROVAL	DATE

INSPECTION PLAN

PO NUMBER _____ REV _____ EQUIPMENT/MATERIAL _____

ONE COPY OF THE DOCUMENTATION CHECKED BELOW WHEN APPLICABLE MUST BE SUBMITTED BY SELLER.

- ☐ CODE DATA REPORTS
- ☐ CMTRs
- ☐ HEAT TREAT CHARTS
- ☐ TRACEABILITY REPORTS
- ☐ PERFORMANCE TEST CURVES
- ☐ VIBRATION TEST CERTIFICATIONS
- ☐ NOISE TEST CERTIFICATIONS
- ☐ HYDRO TEST CERTIFICATIONS
- ☐ NDE CERTIFICATIONS
- ☐ SUBTIER PO
- ☐ MFG DATA BOOK
- ☐ OTHER (SPECIFY)

REMARKS _____

PROCEDURES AND QUALIFICATIONS CHECKED BELOW ARE SUBJECT TO REVIEW AND ACCEPTANCE PRIOR TO FABRICATION

PROCEDURES

- ☐ QA/QC
- ☐ WELDING
- ☐ WELDING REPAIR
- ☐ TEST
- ☐ HEAT TREAT
- ☐ NDE

QUALIFICATIONS

- ☐ WELDER/OPERATOR
- ☐ NDE PERSONNEL

ATTACHED IS THE INSPECTION PLAN FOR THE EQUIPMENT LISTING HOLD POINTS AND INSPECTIONS THAT SHALL BE WITNESSED BY POCO OR RTD

SWTG-094A 0388

SWTG FORM 94B - INSPECTION PLAN

****SOUTHWEST TRANSIT GROUP

PROCEDURE NO	PAGE OF
REVISION NO	DATE
APPROVAL	DATE

INSPECTION PLAN

ITEM _____

CODE _____

LEGEND
- C RTD
- W WITNESS/HOLD POINT
- I INSPECT/RANDOM SPECIFIED
- RA REVIEW DOCUMENT REPORT AND ACCEPT

ITEM	DESCRIPTION OF INSPECTION	REF	MFR/ CONTR	SWTG	CTA	DPW

SWTG 094B 0388

Part 6: Inspection, Measuring, and Test Equipment

**A section entitled "Calibration of Measurement and Test Equipment"
from the SWTP Construction Management Plan,
Quality Assurance/Quality Control Procedures.**

Some definitions are required for abbreviations used in the text:

DPW City of Chicago, Department of Public Works; the agency responsible for design, procurement, construction, and operation of the Southwest Transit system.

QAM Quality Assurance Manager

QCM Quality Control Manager

RE Resident Engineer

RTD Routed - Paperwork attached to an article to be inspected at various locations.

SWTG Southwest Transit Group (the Joint Venture of the Ralph M. Parsons Company; De Leuw, Cather & Company, William E. Brazley and Associates, Ltd.; C.F. Moore Construction Company; and Dubin, Dubin and Moutoussamy doing business as SWTG, engaged by DPW as Construction Manager for the Southwest Transit Project.)

CALIBRATION OF MEASUREMENT AND TEST EQUIPMENT

Measurement and test equipment (tools, gauges, instruments, and other measuring and test equipment) shall be controlled and periodically calibrated and adjusted to maintain accuracy within the necessary limits.

RESPONSIBILITIES

RE shall:

(1) Identify and list measurement and test equipment required for each contract they administer.

(2) Maintain necessary controls to ensure only calibrated equipment is used on their contract.

(3) Ensure only qualified personnel calibrate measurement and test equipment.

(4) Review calibration procedures to be used on contracts they administer.

QCM shall:

(1) Maintain master file and calibration record measurement and calibration equipment used on the project.

(2) Approve calibration test procedures, calibration certificates and reports, and indicate, based on usage and environmental conditions, the calibration intervals for measurement and test equipment.

(3) Develop and maintain a calibration program using either qualified construction management personnel on the services of a certified laboratory approved by the DPW.

(4) Assist, as necessary, RE and Inspectors.

QAM shall:

(1) Through surveillance and audit of CM, contractors, and laboratories, verify that the systems for control and calibration of measurement and test equipment are working adequately.

(2) Assist QCM and RE as necessary.

CALIBRATION PROCEDURES

Calibration procedures may consist of the following:

(1) Procedures contained in a technical publication of the National Bureau of Standards or a recognized manufacturer's instruction manual and approved by the QCM.

(2) Procedures reviewed and approved by the QCM and concurred in by QAM as meeting National Bureau of Standards requirements.

****SOUTHWEST TRANSIT GROUP

CALIBRATION RECORD AND INSTRUMENT STATUS (CRIS)

NAME OF EQUIPMENT _____

RTD OR CONTRACTOR SERIAL NO _____

FREQUENCY OF CALIBRATION _____

LOCATION OF EQUIPMENT _____

PROCEDURE NAME AND NUMBER _____

DATE CAL	IS CODE	DUE DATE	INITIALS	DATE CAL	IS CODE	DUE DATE	INITIALS	DATE CAL	IS CODE	DUE DATE	INITIALS

SWTG 080 0388

SWTG FORM 082 - CALIBRATION STATUS OF TEST EQUIPMENT

◆◆◆◆SOUTHWEST TRANSIT GROUP

CALIBRATION STATUS OF TEST EQUIPMENT

ITEM CALIBRATED	SERIAL NUMBER	CALIBRATION DATE		STANDARD NUMBER/DATE	SIGNATURE/INITIALS OF PERSONNEL PERFORMING CALIBRATION	CALIBRATION RESULTS
		LAST	NEXT			

SWTG 082 0388

Part 7: Nonconformance and Corrective Action

A section entitled "Control of Discrepant Items and Corrective Action" from the RCC

A form and instructions for reporting nonconformances from the LIRR

Control of Discrepant Items and
Corrective Action

1.0 Purpose

To define the control of discrepant items from the point of identification through corrective action and verification.

2.0 Scope

This procedure for control of discrepant items, or its RCC approved equivalent, will be implemented on all RCC projects.

3.0 Policy

3.1 A Discrepant Items Reporting Procedure will be implemented to assure that items that may not conform to established requirements are identified, segregated and removed from work operations to prevent use until adequate disposition is made. Items will be dispositioned as either reject, rework, repair or use-as-is.

3.2 Discrepant items have two levels of control utilizing the following forms:

- Deficiency Notice (DN)

  A Deficiency Notice is used for rejected items or in-process notification of routine discrepancies that can be corrected by rework within a reasonable time period. Reference Exhibit 12-1, DN Form and 12-3, DN Continuation Sheet.

- Noncomformance Report (NCR)

  A Nonconformance Report is used when a deficiency or indeterminate condition is identified that requires a repair or use-as-is disposition. Reference Exhibit 12-5, NCR form and Exhibit 12-7, NCR Continuation Sheet.

- The Construction Manager or contractor/supplier may implement its existing system and forms provided the system meets the requirements of this procedure.

4.0 Definitions

Accept-As-Is: A disposition which allows the use of an item that is does not meet all requirements, when it is determined by Design Engineering that the item will satisfy its intended use. (See Use-As-Is)

Conformance: An affirmative indication or judgment that the condition of an item meets the requirements of relevant specifications, contracts or regulations; also the state of meeting the requirements.

Corrective Action: Documented commitment of specific action planned or being implemented to resolve a known condition or conditions which adversely effect quality.

Corrective Action Request: A document issued to the senior management of a group whose activities are not meeting project requirements. This is a significant document which, in effect,

warns the RE/contractor or others that continuing deficient activities will result in consideration of contract default.

Deficiency: The condition of an item that is questionable as to its acceptability to meet project requirements but does not affect form, fit or function and can be corrected by re-work within a reasonable period of time.

Deficiency Notice (DN): A form used to document deficiency(s), report disposition of the deficiency and initiate and verify corrective actions. DNs are used for REJECT and REWORK dispositions.

Disposition: A statement describing the manner in which a deficiency or nonconformance is to be resolved.

Nonconformances: A major discrepancy in characteristic, documentation or procedure which affects form, fit or function and renders the quality of an item unacceptable or indeterminate in regard to meeting all relevant project requirements. Examples of Nonconformance include, physical defects, test failures, incorrect or inadequate documentation or deviation from prescribed processing, inspection or test procedures.

Noncomformance Report (NCR): A form used to identify a nonconformance and to document a proposed disposition for consideration by the appropriate organization, i.e., Resident Engineer, Design Engineering, Quality Assurance, Safety, etc. Nonconformance Reports are used for REPAIR and USE-AS-IS dispositions.

Quality: The degree of conformance of an item to specified requirements. Deviations from requirements create a discrepancy.

Reject: Reject is a disposition which indicates that the item is unsuitable for its intended purpose and economically or physically incapable of being reworked or repaired.

Repair: Work required which will result in making an item acceptable for its intended use even though it is not restored to a condition which meets all specification requirements.

Rework: Rework is a disposition which indicates that the deficiency can be brought into conformance with the original requirements through remachining, reassembling, reprocessing, reinstallation, or completion of the required operations.

Use-As-Is: See Accept-As-Is.

5.0 Responsibilities

5.1 Construction Manager

- The Resident Engineer (RE) at each construction site will be responsible for implementing control of discrepant items in accordance with this procedure.
- The following will be implemented to control and track DNs and NCRs issued by the Resident Engineer:
- Each DN and NCR will be serialized sequentially by contract. Serial numbers will consist of the CONTRACT NUMBER, YEAR, SEQUENCE NUMBER. Example:B2319101.

- A separate log will be maintained for DNs and NCRs for each contract. Refer to Exhibits 12-4 and 12-8.

- Completed DN's and NCR's with all back-up documentation will be maintained by the Resident Engineer as project quality records.

- The Resident Engineer is responsible for all DN activities including preparation, disposition evaluation, coordination, acceptance of corrective actions, and close-out.

- The Resident Engineer is responsible for initiating and coordinating reviews and dispositions of NCRs with the responsible technical engineering organization, quality assurance, safety and other organization as required.

- Inspections will be conducted to verify corrective actions have been accomplished in accordance with the disposition of the DN or NCR.

- Quality Assurance will review each NCR to determine if the condition indicates a breakdown in the controls established to ensure the effectiveness of the Quality Program and to ensure that corrective actions and their implementation resolve the problem.

5.2 If a breakdown in the Quality process is determined, the cognizant Manager, Quality Assurance, will issue a Corrective Action Request to the responsible manager with copies to the appropriate Program Director and the RCC Director of Quality Assurance. (See Sec. 7.0)

6.0 PROCEDURE

6.1 Deficiency Notice (DN)

- A DN will be prepared for conditions that do not conform or are questionable in conforming to requirements.

- The organization responsible for the deficiency will propose a disposition of:

    - REJECT: A condition that is unsuitable for its intended use and requires replacement, or

    - REPAIR: A condition that can be made suitable for use, but will not meet all design/functional requirements, or

    - ACCEPT-AS-IS: A condition that the item will satisfy its intended use, but will not all meet design/functional requirements.

    - REWORK: A condition that can be brought back into compliance with all project requirement documents.

    - If it is determined that the disposition is REPAIR or ACCEPT-AS-IS transfer the item to a nonconformance report and close the deficiency (DN).

- Repair and accept-as-is conditions will be documented and processed on an NCR.

- The organization responsible for the deficiency will specify in detail, with appropriate re-inspections and/or tests, the actions required to rework the item and return it to conform to the requirements documents.

- Instructions for completing the DN are described in Exhibit 12-2.

6.2 Nonconformance Report (NCR)

- A Nonconformance Report will be prepared if the discrepant item cannot be returned to its original condition.

- REPAIR: Restoring an item to a condition that will make it acceptable for its intended use.

- ACCEPT-AS-IS: Recognition that a discrepant item will satisfy its intended use in spite of the nonconforming condition.

- A description of the nonconformance as well as a detailed disposition and justification will be prepared by the group responsible for the condition. Additionally the responsible party will state the root cause of the problem and actions that will be taken to preclude repetition.

- The cognizant Engineer is responsible for the review and approval of the disposition and verification of the corrective actions.

- Consideration of the disposition will include review of potential hazards.

- Instructions for completing the NCR are described in Exhibit 12-6.

6.3 CLOSE-OUT

- Resolution of discrepancies dispositioned as reject, rework or repair will be verified after implementation by the responsible quality organization.

- After verification, the DN or NCR will be signed off by the inspector, filed and the appropriate log updated.

- Each NCR will be reviewed by CM-QA to determine if the conditions indicate a breakdown in controls established to ensure adherence to quality. If it is determined that such breakdown exists a Corrective Action Request will be initiated.

7.0 CORRECTIVE ACTION

7.1 Corrective Action Procedures will be invoked when conditions adverse to quality indicate a breakdown in controls established to ensure adherence to quality requirements. Identified need for Corrective Action will be reported promptly to the responsible consultant, the RCC VP/Project Managers, and to the RCC Director of Quality Assurance.

7.2 When the need for a Corrective Action Request is identified, the responsible Quality Assurance organization will prepare a Corrective Action Request form (CAR) Figure 12-9 which identifies the organization (name, address and telephone number) to which the request is directed and the originator of the request. Additional information regarding program, location, item, inspection/deficiency/nonconformance report number, and dates for the request and reply due date are also documented. A description of the condition requiring Corrective Action and a statement of apparent cause will be included on the CAR.

7.3 Upon receipt of the CAR the responsible organization will immediately evaluate the actions required and within 10 days implement the following Corrective Action:

- ...Determine the cause of the adverse condition(s)
- ...Establish the corrective action required
- ...Establish the action(s) needed to prevent recurrence.

The above actions will be documented on the CAR form and the form transmitted to the responsible Quality Assurance organization.

7.4 The responsible Quality Assurance organization will evaluate the disposition and corrective action taken or to be taken and advise the responsible organization of the acceptability or unacceptability of the actions. If the actions are unacceptable the responsible QA Manager will meet with the responsible organization or elevate the problem to management.

7.5 When Corrective Action activities are implemented and complete, the responsible Quality Assurance Manager will evaluate results of Corrective Action, close out the CAR and update the CAR Log. Copies of the closed CAR will be distributed to the RCC Director of Quality Assurance, senior project management, and the organization responsible for the action.

7.6 CAR's written by RCC Quality Assurance will be routed to the responsible organization for processing per Sec. 7.0 of this procedure and returned to the originator for concurrence in the disposition.

8.0 DN's, NCR's, and CAR's are quality records and will be maintained in accordance with approved written procedures.

9.0 Attachments

Exhibit 12-1 - Deficiency Notice (DN)
Exhibit 12-2 - Deficiency Notice Instructions
Exhibit 12-3 - Deficiency Notice Continuation Sheet
Exhibit 12-4 - Deficiency Notice Log
Exhibit 12-5 - Nonconformance Report (NCR)
Exhibit 12-6 - Nonconformance Report Instructions
Exhibit 12-7 - Nonconformance Report Continuation Sheet
Exhibit 12-8 - Nonconformance Report Log
Exhibit 12-9 - Quality Assurance Corrective Action Request (CAR)
Exhibit 12-10 - Corrective Action Request Continuation Sheet
Exhibit 12-11 - Corrective Action Request Instructions

RCC Deficiency Notice EXAMPLE

1. Contract No:	2. Contractor/Supplier	3. Spec/Drawing No:	DN No:
5. Deficiency Description/Location/Impact:			
6. Disposition ☐ Reject ☐ Rework ☐ Transfer to NCR _____ (For Repair or Use-As-Is)			
7. Prepared By: Date:	8. Reply Requested From: Date:	9. Concurrance: Date:	
10. Disposition Instructions:			
11. Prepared By: Date:	12. RE Approve: Date:	13. Effectivity: Date:	
14. Verify Work Completed/Acceptable:			
15. Inspection Acceptance: Date:	16. Distribution:		

Exhibit 12-1

Deficiency Notice Instructions

EXAMPLE

1. *Enter the contract number.*
2. *State the contractor or supplier's complete name.*
3. *Enter the applicable specification or drawing number.*
4. *Current DN number obtained from the DN Log.*
5. *Deficiency description.*
6. *Disposition REJECT or REWORK. If the deficiency is REPAIR or USE-AS-IS transfer to an NCR.*
7. *Person Preparing the DN signature and date.*
8. *Enter the person's name and response due date you are requesting the response from.*
9. *RE review and concur, signature and date.*
10. *Describe tasks required to correct the deficiency.*
11. *Signature of the person who prepared the disposition and date.*
12. *RE review and concur, signature and date.*
13. *RE enter the date the disposition/corrective actions will be implemented.*
14. *RE Field inspection verify the work is complete and acceptable. Describe inspections, location, serial number, etc., as appropriate.*
15. *RE Field Inspector indicate acceptance by signature and enter the date.*
16. *Indicate distribution as required.*
    - *The original remains in the RE files.*
    - *A copy is sent to the Manager, QA/QC*

EXHIBIT 12-2

RCC

Deficiency Notice Continuation Sheet

EXAMPLE

Page ___ of ___

Contract No:	Contractor/Supplier:	Spec/Drawing No:	DN No:

Exhibit 12-3

RCC Deficiency Notice Log			Contract Name: EXAMPLE Contract Number: Page ___ of ___					
DN No:	Description:	Originator:	Resp. Org.	Issue Date:	Date Due:	REC Date:	Verified By/Date:	Closed Date:

EXHIBIT 12-4

RCC

Quality Assurance Nonconformance Report

EXAMPLE

Page ___ of ___

1. Contract No:	2. Location:	3. Date:	4. NCR No:
5. Contractor/Supplier:	6. Spec./Drawing No:	7. Originator: Phone:	
8. Nonconformance Description:			
9. Reviewed By: Date:	10. Reply Request From:	11. Reply Due Date:	
12. Root Cause of the Problem:			
13. Disposition: ☐ Reject ☐ Rework ☐ Repair ☐ Use-As-Is			
14. Disposition Instructions:			
15. Prepared By: Date:	16. Effectivity: Date:	17. RE Approval: Date:	
18. Engineering Approval (Repair And Use-As-Is Dispositions) Date:		19. Quality Assurance: Date:	
20. Verification Nonconforming Condition Corrected:			
21. Inspection Or QA Acceptance:		22. Date:	

EXHIBIT 12-5

Nonconformance Report Instructions

EXAMPLE

1. *Enter the contract number.*

2. *Location of incident, material, hardware, etc.*

3. *Date the NCR is prepared.*

4. *NCR number obtained from the NCR log.*

5. *State contractor or suppliers complete name.*

6. *Applicable specification or drawing number.*

7. *Originator's signature and work phone number.*

8. *Describe the nonconformance in detail.*

9. *Responsible RE signature, verify complete, legible and accurate description. QA Manager approval for QA initiated NCR's.*

10. *Enter the persons name and title responsible for investigating, providing root casue and corrective action(s).*

11. *Enter the date the reply is due back to the originator.*

12. *Person identified in Block 10 is responsible for investigating and describing the root cause of the nonconformance and providing corrective action disposition.*

13. *Enter the appropriate disposition, refer to QA nonconformance procedure for definition.*

14. *Describe the actions and responsibilities for correcting the nonconformance and preventing reoccurrence.*

15. *Signature of the individual preparing the disposition and date.*

16. *Date the corrective action will be completed/effective.*

17. *RE signature and date indicating approval of the corrective actions and date.*

18. *Engineering approval for REPAIR or USE-AS-IS dispositions.*

19. *Quality Assurance Manager, or designee, indicating review of the process and concurrence with corrective action(s).*

20. *RE Field Inspection verify the work is complete and acceptable. Describe inspections, location, serial number, etc., as appropriate.*

21. *RE Field Inspector enter the date of verification and acceptance.*

When the NCR is closed/completed:

- *The original remains in the RE files.*
- *A copy is sent to the Manager, QA/QC.*

EXHIBIT 12-6

RCC

Quality Assurance
Nonconformance Report
(Continuation Sheet)

EXAMPLE

Page ___ of ___

1. Contract No:	2. Location:	Date:	NCR No:

EXHIBIT 12-7

RCC Nonconformance Report Log			Contract Name: EXAMPLE Contract Number: Page ___ of ___					
NCR No:	Description:	Originator:	Resp. Org.	Issue Date:	Date Due:	REC Date:	Verified By/Date:	Closed Date:

EXHIBIT 12-8

RCC

Quality Assurance
Corrective Action Request

EXAMPLE

Page ___ of ___

1. Responsible Individual/Organization:	3. CAR No:	4. Date Requested:
	5. Response Date:	6. Reviewed By:

2. Originator: 7. DN/NCR/AFR No:

8. Contract No: 9. Spec/Drawing No: 10. Item Location:

11. Requirement Reference And Description Of Condition:

12. Problem Cause:

13. Action Taken To Prevent Recurrence:

14. Prepared By: 15. Response Date: 16. C/A Implementation Date:

17. Corrective Action: 18. Approval: 19. Quality Assurance Date:

☐ Accept ☐ Reject

20. Verification Of Corrective Action:

21. C/A Implementation: 22. Approval: Date:

☐ Accept ☐ Reject

EXHIBIT 12-9

RCC

Quality Assurance
Corrective Action Request
(Continuation Sheet)

EXAMPLE

Page ___ of ___

Responsible Individual/Organization:	CAR No:	DN/NCR/AFR No:

EXHIBIT 12-10

Corrective Action Request Instructions

EXAMPLE

Blocks 1 through 12 will be completed by the individual issuing the CAR.

1. *Enter name (internal/external) or responsible individual/organization.*

2. *Enter name and telephone number of individual issuing Corrective Action Request.*

3. *Enter CAR number.*

4. *Enter date CAR was generated.*

5. *Enter date the reply is due back to the originator (normally ten [10] working days after date of issue.*

6. *Originator's supervisor or manager review, sign and date.*

7. *Reference Discrepancy Notice (DN) number, Nonconformance Report (NCR) number, Audit Finding Report (AFR) number if applicable.*

8. *Enter contract number.*

9. *Enter specification/drawing procedure.*

10. *Location of incident, material, hardware, etc.*

11. *Reference the requirement and describe the existing condition.*

Blocks 12 through 16 will be completed by the individual responsible for responding to the CAR

12. *Describe the probable cause.*

13. *Describe the corrective action/action to prevent recurrence/action to correct the immediate problem.*

14. *Signature of the individual preparing item #12.*

15. *Enter date.*

16. *Enter effectivity/implementation date.*

17. *Initiating organization will review corrective action check either accept/reject (a plan is acceptable).*

18. *Signature of individual approving item number 16 and date.*

19. *Quality Assurance signature and date.*

Blocks 20, 21 & 22 will be completed by responsible organization.

20. *Responsible Quality organization (RE QC or QA).*

21. *Enter either accept/reject Correction Action implementation.*

22. *Enter signature of individual and date verifying C/A implementation.*

EXHIBIT 12-11

NONCONFORMANCE REPORT

NCR No.

(PRINT CLEARLY - Use additional sheets as necessary)

IDENTIFICATION

1. PN_____ 2. TASK NO. _____

3. TASK DESCRIPTION: _____

4. ISSUED TO: _____ 5._____
(NAME, TITLE) (COMPANY/DEPARTMENT)

NONCONFORMANCE

6. DETAILS OF NONCONFORMING CONDITION:

7. REFERENCE CRITERIA:
[DWG, SPEC, PO, PROCEDURE WITH NOs, REV, PARAGRAPH; PREVIOUS NCR No., etc.]

_____
_____
_____
_____
_____
_____
_____

8._____ _____
(INITIATOR, TITLE) (DATE)

NONCONFORMANCE REPORT

(PRINT CLEARLY - Use additional sheets as necessary)

NCR No.

IDENTIFICATION 1. PN_____ 2. TASK NO. _____

3. TASK DESCRIPTION: _____

DISPOSITION (INCLUDE FORECASTED DATES OF COMPLETION WHEN POSSIBLE)

9. CORRECTIVE ACTION:

10. PREVENTIVE ACTION:

11._____ _____
(DISPOSITIONER, TITLE) (DATE)

DISPOSITION CONCURRENCE:

ENGINEER OF RECORD (EOR) CONCURRENCE REQUIRED:

12._____ _____ 13. YES / NO _____ _____
(CM RECOMMENDATION) (DATE) (PM INITIALS) (DATE)

14._____ _____ 15._____ _____
(EOR CONCURRENCE) (DATE) (PM CONCURRENCE) (DATE)

NONCONFORMANCE REPORT

NCR No.

(PRINT CLEARLY - Use additional sheets as necessary)

IDENTIFICATION 1. PN_____ 2. TASK NO. _____

3. TASK DESCRIPTION: _____

VERIFICATION (IDENTIFY ALL ATTRIBUTES REVIEWED TO SUBSTANTIATE SATISFACTORY COMPLETION OF DISPOSITION ACTION(S); INCLUDE RECORDS OF INSPECTION, EXAMINATION, MEASUREMENT, TESTING, TRAINING, AND REVISION OF DRAWING, SPECIFICATION, PROCEDURE, ETC.)

16. COMPLETION VERIFICATION:

17._____ _____
(VERIFIER, TITLE) (DATE)

18. NEW NCR No.

19._____ _____
(PM CLOSURE) (DATE)

INSTRUCTIONS for Completing the Nonconformance Report MP-902-1

A. A Nonconformance Report (NCR) shall be written when it is noted (usually through inspection) that contrary to specified requirements, the quality of an item is unacceptable or indeterminate.

B. Nonconforming conditions shall be documented by accountable individuals who shall complete the NCR form by entering pertinent information in the spaces provided, referencing/attaching supporting documents as applicable.

C. The numbered spaces on the NCR correspond with the numbers listed below, with a description of the information that is required to be entered on the NCR as follows:

I. IDENTIFICATION BLOCK

1. Project Number. 2. Task Number.
3. Task Descriptopn - as listed in THE "CENTRAK" System.

NOTE: The above information (1 through 3) must be entered on each NCR Page.

II. NONCONFORMANCE BLOCK

4. Name and title of "Issued to" individual responsible for correction of the nonconforming condition.
5. Company or RailRoad Department of representative named in 4.
6. Concise description of noted condition, include a "statement" of:
   - o the reference criteria requirement(s);
   - o the existing nonconforming condition, with location; and
   - o the date by which the disposition is needed, if possible. (e.g., "In accordance with 'referenced Dwg.'[S-4, rev.1], anchor bolts are to be installed with a spacing of 4". In this area (state specific location) the installed bolts have a spacing of 8". Disposition is needed by (date) to facilitate (the next work activity, etc.)."
7. Identification of Reference Criteria from which the noted condition deviates (name, number, revision, paragraph of Drawing, Spec., PO, Procedure, etc.).
8. Name and title of the NCR "initiator" and the date the NCR is generated.

FORWARD THE NCR TO THE PM WHO SHALL PROVIDE THE NCR NUMBER.

INSTRUCTIONS for Completing the Nonconformance Report MP-902-2

A. A Nonconformance Report (NCR) shall be written when it is noted (usually through inspection) that contrary to specified requirements, the quality of an item is unacceptable or indeterminate.

B. Nonconforming conditions shall be documented by accountable individuals who shall complete the NCR form by entering pertinent information in the spaces provided, referencing/attaching supporting documents as applicable.

C. The numbered spaces on the NCR correspond with the numbers listed below, with a description of the information that is required to be entered on the NCR as follows:

I. **IDENTIFICATION BLOCK**

1. Project Number. 2. Task Number.
3. Task Descriptopn - as listed in THE "CENTRAK" System.

NOTE: The above information (1 through 3) must be entered on each NCR Page.

II. **DISPOSITION BLOCK**

9. Step by step process which is to correct the nonconforming condition, with forecasted dates of completion.
10. Measures to prevent the condition from recurring, i.e., "(re)instruction/(re)training of personnel and/or the revision of procedures/specifications, with forecasted dates of completion".
11. Name and title of the NCR "dispositioner", and the date the corrective/preventive "action(s)" is dispositioned.
12. The CM, if any, indicates recommendation for PM concurrence of the disposition "action(s)", via CM signature & date.
    The CM indicates objection by returning the NCR, unsigned, to the "dispositioner", with a separate written explanation.
    The PM indicates disapproval of the disposition by returning the NCR, unsigned, to the "dispositioner", with a separate written explanation.
13. The PM indicates if the Engineer of Record (EOR) is required to concur with the disposition "action(s)" by circling either yes or no, and entering PM initials.
14. The EOR documents concurrence of the "action(s)" via EOR signature, title, and date.
    The EOR indicates objection by returning the NCR, unsigned, to the PM, with a separate written explanation.
15. The PM documents concurrence of the disposition "action(s)", via PM signature and date.
    The disposition work may proceed.

INSTRUCTIONS for Completing the Nonconformance Report MP-902-3

A. A Nonconformance Report (NCR) shall be written when it is noted (usually through inspection) that contrary to specified requirements, the quality of an item is unacceptable or indeterminate.

B. Nonconforming conditions shall be documented by accountable individuals who shall complete the NCR form by entering pertinent information in the spaces provided, referencing/attaching supporting documents as applicable.

C. The numbered spaces on the NCR correspond with the numbers listed below, with a description of the information that is required to be entered on the NCR as follows:

I. IDENTIFICATION BLOCK

1. Project Number. 2. Task Number.
3. Task Descriptopn - as listed in THE "CENTRAK" System.

NOTE: The above information (1 through 3) must be entered on each NCR Page.

II. VERIFICATION BLOCK

16. The PM Designee ("verifier")references/attaches supporting documents as applicable, e.g., inspection reports, records of training sessions, revised drawings, procedures, etc.
17. The PM Designee indicates verification of satisfactory completion of the disposition work, via PM Designee signature, title, and date.
    The PM Designee indicates nonverification, or unsatisfactory completion, by returning the NCR, unsigned, to the PM, with a separate written explanation. NOTE: The PM shall determine the need for additional documentation (No.16), completion of original disposition work (Nos. 9, 10), or a new disposition through the generation of a new NCR.
18. The PM enters new NCR No., when applicable.
19. The PM indicates NCR CLOSURE, that the Disposition completion is adequately substantiated, or that a new NCR is generated, via PM signature and date.

Part 8: Quality Records

From the RCC Quality Assurance Program Manual

Quality Records

1.0 Purpose

To set forth the requirements for collection and maintenance of records which provide objective evidence of quality.

2.0 Scope

This procedure includes requirements for the collection and maintenance of Quality Records for design, procurement, construction, installation, inspection, test, and operational activities.

3.0 Policy

Quality Assurance records are to be collected, retained and stored in a controlled and readily retrievable manner.

4.0 Requirements

4.1 Quality Records will be collected, stored and preserved in a manner which precludes damage, loss or deterioration and retention time shall be defined.

4.2 Quality Records will be identified by title, contract number, revision, activity description, date and signature as appropriate.

4.3 Quality Records are to be available to authorized persons as required.

5.0 Procedure

5.1 Quality Records will be categorized as 1) Permanent Quality Records or 2) Non-Permanent Quality Records.

5.2 Permanent Quality Records are those which involve:

- Design development
- Demonstrated capability for proper function and safe operation of critical items
- Maintaining, reworking, repairing, replacing, or modifying an item
- Determining the cause of an accident or malfunction of an item
- Providing required baseline data
- Documenting the results of inspections and tests

5.3 Non-permanent Quality Records are those which do not meet one of the above criteria for permanent records.

5.4 Quality Records will be considered valid only if stamped, initialed, or signed as well as dated by authorized personnel. These records may either be the original or a reproduced copy.

5.5 Corrections/revisions to Quality Records are to receive as a minimum the same review and approval as the original document.

5.6 Quality Records are subject to Quality Assurance audits.

6.0 Transmission and Retention of Quality Records

6.1 Quality Records will be prepared, filed and maintained in accordance with approved procedures in such a manner that will make them readily retrievable when requested by authorized personnel.

6.2 Contractor/suppliers are responsible for retention of Quality Records during the period of construction, assembly and/or installation, and testing.

6.3 Storage facilities for Quality Records will include fire resistant steel file cabinets or other storage containers located within an area having features that preclude damage from fire, condensation, and extreme temperature variation. In lieu of fire resistant files a second (backup) copy of each quality record will be maintained in an area remote from the primary storage described above.

6.4 Specific retention requirements for Quality Records are to be approved by RCC.

6.5 Unless otherwise stated in the contract the Quality Records will be turned over to RCC at the completion of the contract.

7.0 Quality Records

7.1 Types of documents that are considered Quality Records:

- DESIGN RECORDS

  Design Procedures and Manuals
  Applicable Criteria Used in Design
  Design Calculations and Checks
  Drawings (Standards, Reference, Directive, Contract, As-Built, Shop, Working)
  Design Review Reports
  Design Deviations and Changes
  Contract Specifications
  Quality Assurance System Audit Reports

- PROCUREMENT RECORDS

  Procurement Procedures and Manuals
  Surveillance Inspection Reports
  Pre-Award Surveys
  Contract Specifications and Modifications
  Certificates of Compliance
  Quality Assurance System Audit Reports
  Test Results
  Applicable Contract Data Items

- CONSTRUCTION, MANUFACTURING, INSTALLATION RECORDS

  Drawings
  Contractor Data Submittals
  Quality Assurance Manual and Plans
  Process and Personnel Certifications
  Inspectors' Daily Reports
  Material Certifications

Test Reports and Data
Nonconformance Reports
Surveillance Inspection Reports
Deficiency Notices
Release for Shipment Notices
Quality Assurance Process Audits
Specific Documentation Required for the Safety Certification Program
Test Witness Reports

- OPERATIONAL RECORDS

Maintenance actions (corrective and preventive)
Inspection records
Quality Assurance Operational Audits
Personnel Certifications
Retrofit Records

7.2 The above list is a guide to documents considered Quality Records and should not be construed as a complete listing.

Part 9: Quality Audits

From the RCC Quality Assurance Program Manual

Audits

1.0 Purpose

To establish the requirements for performing quality audits of RCC project activities.

2.0 Scope

Includes quality audits performed by RCC, its Engineering Management Consultants, its Construction Management Consultants, and/or other consultants for all RCC projects. As applicable, this procedure may be used for performance of System Safety and Safety Certification audits.

3.0 Policy

A comprehensive program of planned and periodic audits will be established to verify that applicable elements of the Quality Assurance Program are acceptable and have been developed, documented and effectively implemented in accordance with specified requirements.

4.0 Procedure

4.1 The activities of consultants, contractors, and selected major suppliers will be audited for compliance and implementation of contractually required Quality activities, including evaluation of program effectiveness.

4.2 The lead auditor assigned is responsible for all elements of the audit. Auditors are to have no direct responsibility in the activities to be audited. Auditors will have experience or training commensurate with the scope, complexity, or special nature of the activities to be audited.

4.3 Audit records include audit schedules, audit plans, audit reports, audit checklists, audit performance records, and Corrective Action Requests as applicable.

4.4 Audits will be scheduled and performed on a selected basis with a frequency commensurate with the activities on the project or as indicated by previous audits. Follow up audits to verify completion and the effectiveness of corrective action are to be scheduled as required.

4.5 An Audit Schedule (Exhibit 14-1) will be maintained by each organization on RCC projects, as applicable, and submitted to the RCC Director, Quality Assurance.

- The format for planning and conducting an audit may be seen in Section 6.0 (Attachments). The plan must include a definition of the audit scope, the organization to be audited, activities to be audited, suggested audit date(s), auditor's name, and applicable audit checklist. Proper notification of the impending audit is to be transmitted to the organization to be audited.

4.6 Performance of the audit includes the following steps.

4.6.1 A pre-audit conference will be held to establish the ground rules for the conduct of the audit.

4.6.2 The auditor will conduct the audit in accordance with the required plan and checklist. If deficiencies outside the stated scope of the audit checklist are observed during the audit, appropriate action will be initiated as determined by the RCC Director, Quality Assurance, or designee.

4.6.3 The audit must include, but is not limited to, the following as applicable:

- Review for compliance of the documentation required by the quality procedures.
- Interviews conducted with individuals who perform specific activities relating to quality to ascertain that they have a proper understanding of the required procedures.
- Review of operations associated with the audit item including the witnessing of operations to determine adherence to written procedures.

4.6.4 Upon completion, the lead auditor will conduct a post audit conference with management and supervision in the areas audited to review the audit findings. The purpose of this review is to confirm the conditions found, resolve any misunderstandings with respect to observed deficiencies, and to establish corrective action commitments.

4.7 After completion, the auditor is to document the results in an audit report and include reference to:

- The documents reviewed, the location of the documents and the acceptability of items or deficiencies observed in the documentation review..
- The operation reviewed, and the acceptable or non-acceptable areas observed.
- The individuals contacted during the audit and notations of any audit deficiencies found through interviews with persons involved in the performance of tasks. Audit deficiencies shall be documented on an Audit Finding Report (AFR).
- An audit report will be prepared by the auditor, addressed to the management of the audited organization, and distributed to the RCC Director of Quality Assurance.

4.8 The management of the activity audited will normally be required to respond to the audit report within ten working days. Circumstances may arise where responses require additional time or further clarification. Such instances will be resolved directly with the auditor and appropriately documented. The corrective action statements are to be specific with respect to cause of deficiency, as well as actions taken to correct the deficiency and to preclude recurrence.

4.9 The auditor is responsible for accepting or rejecting corrective action responses to audits. The reason for rejection will be stated in writing.

4.10 The auditor is responsible for scheduling follow-up audits when required, to verify completion and effectiveness of corrective action. Deficiencies noted will be handled in the same manner as original findings.

4.11 The auditor will notify senior management of the agency audited and the RCC Director of Quality Assurance upon closure of open items.

5.0 Audit Records are to be maintained and included as Project Quality Records and made available for review and audit.

6.0 Attachments

Exhibit 14-1	-	Audit Schedule
Exhibit 14-2	-	Audit Log
Exhibit 14-3	-	Audit Checklist
Exhibit 14-3a	-	Audit Checklist Continuation Sheet
Exhibit 14-4	-	Audit Finding Report
Exhibit 14-4a	-	Instruction for Completing the AFR
Exhibit 14-4b	-	Audit Finding Report Continuation Sheet

RCC

EXAMPLE

Quality Assurance Audit Schedule

Page ____ of ____

Activity	Jan	Feb	Mar	Apr	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Prepared By: _____ Date: _____

Approved By: _____ Date: _____

EXHIBIT 14-1

RCC

EXAMPLE

Quality Assurance Audit Log

Page ____ of ____

Audit Number	Contract Number	Subject	Audit Dates	Lead Auditor

EXHIBIT 14-2

Organization/Contract No:	Audit No:	Prepared By: Date:	Approved By: Date:
Subject:	Location:	Audit Team Leader:	
	Audit Date(s):	Audit Team Members:	

☐ Supplier Audit ☐ Scheduled Audit ☐ Systems Audit

☐ Facilities Audit ☐ Unscheduled Audit ☐ Product Audit

Item	Audit Element	Reference	Method of Verification	Status
			Auditor:	Date:

EXHIBIT 14-3

EXHIBIT 14-3

RCC

Quality Assurance Audit Checklist
Continuation Sheet

EXAMPLE

Function/Contract No:		Audit No:		
Item	Audit Element	Reference	Method of Verification	Status

EXHIBIT 14-3a

EXHIBIT 14-3a

RCC

Audit Finding Report

EXAMPLE

Page ____ of ____

1. Project/Contract/Supplier:	2. Location		3. AFR No:
4. Subject:	5. Audit Number:	6. Discussed With:	7. Issue Date:
8. Responsible Authority Phone Number		9. Auditor: Phone Number:	
10. Requirement Reference And Description Of Condition			
11. Cause Of The Problem:			
12. Corrective Action:			
13. Responsible Authority:	14. Response Due Date:	15. Response Date:	16. Effective Date:
17. Corrective Action: ☐ Accept ☐ Reject		18. Auditor: Date:	
19. Verification Of Corrective Action(s):			
20. Implementation ☐ Accept ☐ Reject		21. Auditor Date:	

EXHIBIT 14-4

Instructions for Completing Audit Finding Report

Blocks 1 through 10 and 14 will be completed by the Auditor or individual issuing the AFR prior to issuance as follows:

1. *Enter name of project, contract or supplier.*
2. *Enter location of project, contract or supplier.*
3. *Enter AFR number, Contract number and sequence number (B231-1).*
4. *Enter subject of the Finding, i.e., Document Control, Submittal Control, etc.*
5. *Enter Audit Report Number.*
6. *Enter name of individual contracted to discuss the finding.*
7. *Enter issue date of AFR.*
8. *Enter name and telephone number of individual responsible for responding to the AFR.*
9. *Enter name and telephone number of individual(s) issuing the AFR.*
10. *Describe finding by identifying the requirement(s) and the exisitng condition(s).*
14. *Enter response due date (normally 15 working days after date of the issue).*

Blocks 11 through 13, 15 and 16 will be completed by the individual responsible for responding to the AFR.

11. *Enter cause of the problem.*
12. *Enter corrective action/action to prevent recurrence.*
13. *Signature of responsible individual.*
15. *Enter response date.*
16. *Enter effective date.*

Blocks 17 through 21 will be completed by the individual issuing the AFR.

17. *Check box as appropriate.*
18. *Signature of Auditor and date.*
19. *enter activities performed to verify corrective action.*
20. *Check appropriate box.*
21. *Signature of Auditor and date.*

RCC

Audit Finding Report
(Continuation Sheet)

EXAMPLE

Page ____ of ____

Project/Contract/Supplier:	Audit Number	Audit Finding Report

EXHIBIT 14-4b

APPENDIX B - A CHECKLIST FOR THE PREPARATION OF A PROJECT QUALITY PLAN FROM THE LIRR

PROJECT QUALITY PLAN (PQ Plan)
FOR

_____, _____
Project Name Project No.

Prepared By: _____ _____
Project Manager Date
Capital Program Management

(List as many Railroad Department Heads as are appropriate)

Concurred By: _____ _____
Dept. Head/Designee Date

_____ _____
Dept. Head/Designee Date

_____ _____
Dept. Head/Designee Date

_____ _____
Dept. Head/Designee Date

_____ _____
Concurred By: Manager - Quality Date
Assurance Implementation

ISSUE DATE:_____
REVISION: _____

SAMPLE CHECKLIST FOR DEVELOPMENT OF PROJECT QUALITY PLAN - (PQ Plan)

I. Project Plan

A. Project Number: _____

B. Project Name: _____

C. Project Tasks Per Program Plan Book Requiring QA/QC (Identify by Task No. and Title):

_____ _____ _____
_____ _____ _____
_____ _____ _____

D. Force Account Required?:

E. Brief Description of Work to be performed: _____
_____
_____
_____
_____

F. Project Phases required: _____
(Design, Procurement, Construction)

G. Total Cost of the Project:_____

H. Initial Estimated Project Start Date:_____

I. Initial Estimated Project Completion Date:_____

J. List of Relevant Departments/Organizations Needed to support Project:

_____ Purchasing
_____ Contracts
_____ (MofE)
_____ IE
_____ Track
_____ B & B
_____ ET
_____ Signals & Communications
_____ MTA Real Estate
_____ Outside Consultant
_____ Outside Testing
_____ Others (Specify)

II. Design Phase

A. Is approval of sources required?
If yes, by whom (F/A, CM/Consultant, Other)?_____

B. Are source inspections required?
If yes, by whom (F/A, CM/Consultant, Other)? _____

C. Should basic technical requirements be specified or referenced in P.O. or Statement of Work (e.g., drawings, specifications, Engineering orders, special inspection and test requirements with latest applicable revisions)?

D. Are design activities by F/A, Consultant or Both?
Indicate number of submissions and at what level (e.g., Prelim., 30%, 60%, etc...).

E. Who will review design submissions? _____

F. Approval by whom (F/A, CM/Consultant, Other)? _____
(Approval should indicate constructibility, safety, budgetary and scheduling reviews).

G. Design transmittal process must be established by PM. Must process be included in Specification/Contract Documents?
Who will monitor and be involved in transmittal process (F/A, CM/Consultant, Other)? _____

H. Is an RFP or RFQ required? How many?
If yes, by whom (F/A, CM/Consultant, Other)? _____
Indicate number of submissions and at what level?

I. Are field Surveys Required?
If Yes, by whom (F/A, CM/Consultant, Other)? _____

J. Are Railroad records (drawings, logs, specifications, etc...) available for distribution or review by CM/Consultant or other personnel?

III. Procurement Phase

A. Is approval of sources required?
If yes, by whom (F/A, CM/Consultant, Other)? _____

B. Are source inspections required?
If yes, by whom (F/A, CM/Consultant, Other)? _____

C. Should basic technical requirements be specified or referenced in P.O. or statement of work (e.g., drawings, specifications, Engineering orders, special inspection and test requirements with latest applicable revisions)?

D. List major material or systems which shall be inspected and tested by F/A at the LIRR:

_____ _____
_____ _____
_____ _____
_____ _____

E. Are there any critical item(s) that will be purchased?
If yes, specify:_____
_____

NOTE: Critical items are described as those items which are either of a complex nature, a significant dollar value or having long procurement lead time; or as items without which temporary work is difficult, impossible or costly; or as items which have had a poor procurement history in terms of delivery or quality.)

F. Who will review and approve purchase order submissions and changes and how will they be controlled?_____
_____
_____

G. Fabrication/Material Control
1. Will fabrication of any systems or assemblies be by F/A personnel, outside parties (foreign or domestic) or both?
Explain:_____
2. What inspection services are required?
(i.e., Cable test, non-destructive examination, functional test, etc.)

3. Will there be special material processing (eg., plating, encapsulation, casting, other) required?
If yes, what type(s) and will inspection be required?

4. Should Vendor provide Inspection Plan?
If yes, who will approve and monitor (F/A, CM/Consultant, Other)? _____
If no, explain why not:_____

III. Procurement Phase (Continued)

H. Delivery

1. Should Vendor supply shipping plan (special packaging, handling, transport, frequency of shipments, etc)? If yes, who will approve and monitor (F/A, CM/Consultant, Other)? _____ If no, explain why not:_____
_____

2. Who will monitor material delivery to maintain project schedule (F/A, CM/Consultant, Other)?_____
_____

3. Is inspection of major material required upon delivery and by whom (F/A, CM/Consultant, Other)?_____

I. Will certification documentation or data packages be requested from Vendor?

J. Is first article or pre-production testing needed? Specify types of testing:_____
_____

K. Will testing requirements be specified in Contract or P.O.?

L. Will continued in-process or on-going testing and monitoring be required?
If yes, who will support and monitor (F/A, CM/Consultant, Other):?
_____

M. Training/Certification of Operation Personnel

1. Is certification of Operators Required?
2. Must RailRoad personnel be trained?
3. Is special equipment needed?
If Yes, Specify:_____
_____

N. Are special environmental constraints to be considered?
If yes, what type?

_____Rain	_____Humidity
_____Fog	_____Solar Radiation
_____Salt/Corrosion	_____Dust
_____Vibration	_____Shock
_____Bounce (Vehicular)	_____Other

O. Is vendor QC plan required?
If yes, who will approve (LIRR, CM/Consultant, Other)?_____
If no, explain why:_____

P. Is a Vendor manufacturing plan required?

Q. Is a special outside lab testing required?

IV. Installation/Construction Phase

A. Is field testing required?
If yes, by whom (F/A, CM/Consultant, Other)? _____
If no, explain why not:_____

B. Is the inspection of raw material or testing of systems to be performed by F/A at the LIRR?
If yes, specify (e.g., transformers, paint, etc.):_____
_____

C. Is the testing of raw materials to be performed by Contractor/ Consultant?
Specify types of testing (e.g., concrete, paint, other):
_____

D. Will testing requirement be specified in Contract or P.O.?

E. Is in-process or on-going testing and monitoring required?
If yes, who will support and monitor (F/A, CM/Consultant, Other)? _____

F. Is any special outside lab testing required?

G. Training/Certification of Operation Personnel:
1. Is the certification of operators required?
2. Must RailRoad personnel be trained?
3. Is special equipment needed? If yes, specify: _____

H. Upon completion of work, will acceptance testing be required?
If yes, by whom (F/A, CM/Consultant, Other)?_____

I. Will in-house forces provide:
1. Installation Support? explain:_____
2. Testing Support? explain:_____
3. Inspection Services? explain:_____
4. Other? explain:_____

J. How will construction schedule be provided?
How will construction schedule be approved?
Who will monitor the schedule?

K. Are special environmental constraints to be considered?
If yes, what type:

_____Rain	_____Humidity
_____Fog	_____Solar Radiation
_____Salt/Corrosion	_____Dust
_____Vibration	_____Shock
_____Bounce (Vehicular)	_____Bounce

V. Control of Nonconformances/Corrective Action

NOTE: For all three phases Design, Procurement, Installation/ Construction, nonconformance/corrective action shall be controlled in accordance with MP-902.

A. Is Field Inspection required?
If yes, by whom (F/A, CM/Consultant, Other)?_____

B. How will feedback of problems be conveyed to vendor/contractor?
_____
_____

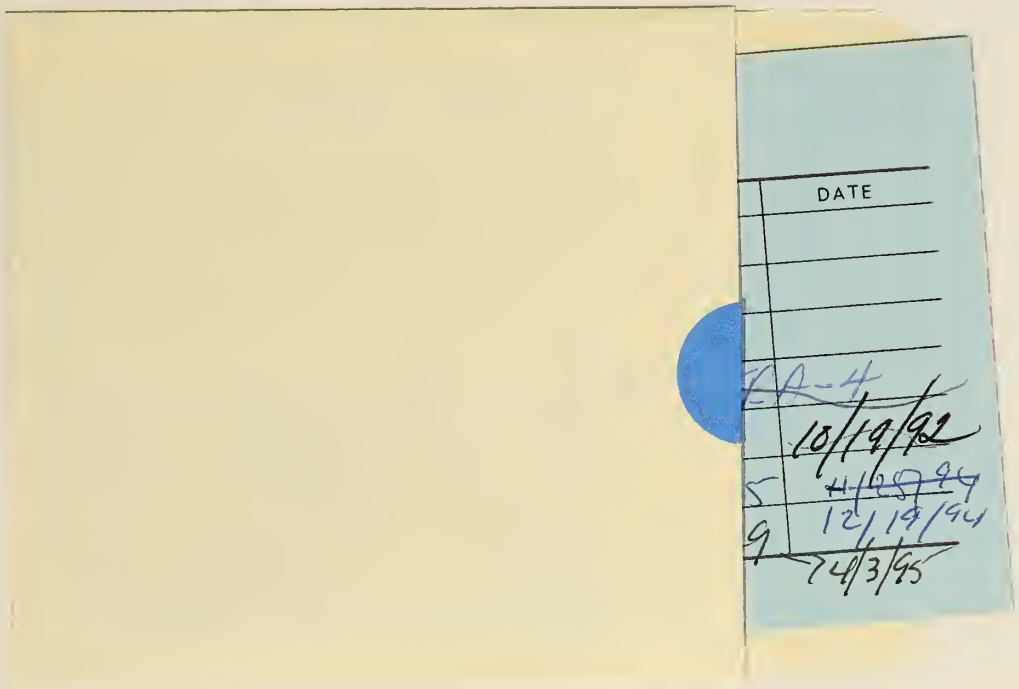
C. How is verification of corrective action accomplished?
Who verifies the satisfactory completion of corrective action?
(F/A, CM/Consultant, Other)?_____

D. Identify personnel responsible for follow-up of nonconformances for each phase of the project:

Design Phase: _____

Procurement Phase: _____

Construction/Installation Phase: _____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