

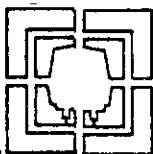
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GENERAL CONSULTANT MANAGEMENT PLAN

for the
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

JULY 1983



METRO RAIL TRANSIT CONSULTANTS

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"The preparation of this document has been financed in part through a grant from the U.S. Department of Transportation, Urban Mass Transportation Administration, under the Urban Mass Transportation Act of 1964, as amended, and in part by the Southern California Rapid Transit District."

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Management Plan

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Metro Rail Transit Consultants

Metro Rail Project

MANAGEMENT PLAN

I. INTRODUCTION

Metro Rail Transit Consultants (MRTC), a joint venture of Daniel, Mann, Johnson, & Mendenhall; Parsons Brinkerhoff Quade & Douglas, Inc.; Kaiser Engineers (California) Corporation; and Harry Weese and Associates LTD., has been retained by The Southern California Rapid Transit District (SCRTD) as the General Consultant (GC) for the Metro Rail Project which is the initial segment of the ultimate rapid transit network for the urbanized area. Direction of the G.C. by SCRTD is through the office of the Assistant General Manager for Transit System Development.

MRTC entered into a contract with SCRTD on May 2, 1983, and work began under the contract on that date. The contract prescribes services to be performed by MRTC which would advance the engineering design of the Metro Rail Project to between 50 and 85 percent of final design. The contract also provides, subject to SCRTD's subsequent direction, for the completion of final design and the preparation of construction and procurement contract documents, systems procurement management and engineering services during construction.

The contract requires that MRTC develop and implement a management plan which defines relationships, assigns responsibilities and delegates specific authorities to the Project Director and the various subordinate managers.

II. OBJECTIVES

Within the context of the MRTC/SCRTD contract and the overall mission of placing the Metro Rail Project into passenger carrying services, the principal objectives of this management plan are: to define the roles, responsibilities, management philosophy and management approach of the G.C.; to describe the organizational structure and managerial framework established to fulfill these requirements; to identify, establish and implement the mechanisms for responding to, fulfilling the needs of and communicating with the SCRTD; and to establish an orderly decision making process and a system of work performance, supervision, coordination and reporting to permit early identification or required actions and correction of problem areas.

III. THE ROLE OF THE G.C.

The planning, design and construction of a new rapid transit system represents one of the most complex public works programs that can be undertaken. The technical complexity of the many elements of the system when combined with the programmatic complexities introduced by federal, state and local funding agency requirements and when superimposed upon the implementation complexities associated with the physical emplacement of a wholly new and continuous structure within an existing urban environment, makes rapid transit system development a most formidable management task. During the last two decades, those areas of the United States that have exhibited the courage and tenacity to embark upon such new programs (Philadelphia, New Jersey, San Francisco, Washington, D.C., Atlanta, Baltimore, Dade County, Fla. and Los Angeles) have employed the services of consultants to assist, augment, and supplement the agencies charged with planning and building the systems. In all cases the need for a general consultant with broad responsibilities was identified. In Los Angeles, work commenced on the preliminary engineering aspects of a rapid transit system in 1981 using numerous consultants including specialty consultants and three general consultants (one each for Ways & Structures, Architecture and Subsystems) reporting directly to the implementing agency and responsible for the management and execution of a wide range of professional services to bring the design to the preliminary (30%) level and develop a preliminary cost estimate. To continue the design in a timely and coordinated manner, SCRTD defined the requirement for a General Consultant for all continuing preliminary engineering, final design and, subject to subsequent direction, certain construction and procurement-related activ-

ities for development of the Metro Rail Project. The role of the G.C. can be broadly defined as providing to the SCRTD the management coordination and performance of all engineering and architectural design services, contract preparation and administration, and authorized procurement management necessary to support the development and implementation of a complete rapid transit system.

IV. THE RESPONSIBILITIES OF THE G.C.

The fulfillment of the G.C. role necessitates a clear understanding of the responsibilities of the G.C. These responsibilities can be summarized as follows:

- o To assist the SCRTD in meeting its commitment to the people of Los Angeles through the design of a system embodying high standards of passenger carrying service, visual quality, and urban planning.
- o To fulfill the needs of the SCRTD as reflected in the MRTC/SCRTD contract, and to fully satisfy the requirements of that contract.
- o To manage, direct, coordinate and execute the required work in accordance with approved schedules and budgets.
- o To exercise its recognized professional judgement, initiative and ability.

It was with these responsibilities in mind that the Metro Rail Transit Consultants joint venture was formed. The joint venture consists of four firms, each successful and respected in its field and each with backgrounds of varying emphasis and capabilities. All four firms share the common goal of contributing their own particular capabilities in fulfillment of the G.C. responsibilities. The successful discharge of these responsibilities requires the melding of the capabilities of the four firms into a fully integrated synergistic, and unified project team. This is a key task among the many management activities required.

V. MANAGEMENT PHILOSOPHY

A. Approach

As in any project, key concerns in the conduct of the program are achievement of the overall budget and schedule requirements while maintaining the quality and integrity of the constructed system. In addressing these concerns, MRTC has established a Management Board to delegate responsibility, to oversee the activities of the joint venture, and to provide the corporate support and direction necessary to achieve the integration of the member firms. The MRTC Management Board has vested responsibility for the administration and technical management of the project office in the Project Director. The Project Director is responsible to the Management Board in much the same way as the chief executive officer of a corporation is responsible to its board of directors. The Project Director has established a unified team and organizational structure for the management and conduct of the specific phase of the program currently being undertaken but adaptable to the future needs of the program. In addition, the managerial framework has been developed to plan, measure, validate and control the work being performed. Subsequent chapters of this management plan deal in some detail with these topics and also describe specific delegations of authority and the mechanisms developed for communicating with and responding to the needs of SCRTD.

B. Special Management Tasks

Management of the G.C. and its activities involves a wide range of tasks many of which are those normally associated with the operation of an architectural, engineering and management group of approximately 200 persons together with more than 20 other professional organizations under subcontract. However, an aspect of the project requiring special management practice is the one client-one project nature of the G.C.'s activities. The MRTC exists only to fulfill the needs of the SCRTD on the rapid transit program and related activities. This exclusive focus for MRTC's activities requires that a special level of flexibility be embodied both in the organizational arrangements established to perform the work and in the skills of the personnel assigned to the project offices by the member firms and hired or transferred by the member firms specifically to work on the project. This flexibility is necessary to accommodate the varying phases of project work without disruptive and uneconomic turnover and replacement of highly skilled personnel. The needs of a project of the scope and magnitude of the Metro Rail Project will fluctuate as the project progresses. Thus, an important management task is the constant review of immediate and future project needs and the matching of project office personnel resources and home office resources to these needs. In addition, the continuity of involvement in the project by the many skilled professional and technical personnel must be fostered through continued assignment to the project in different positions over time. Much depends to a large degree upon the experience of the personnel

involved, their motivation and job flexibility and their willingness to undertake new assignments on the project. All of these attributes are important aspects of the management tasks of employee selection, on-the-job training and individual development and motivation.

VI. ORGANIZATIONAL STRUCTURE

A. Introduction

The fundamental precept underlying the organizational structure is that the basic technical requirements of the project must be served in the most straight forward manner without regard to the corporate affiliation of any individual. In addition, with many months of the preliminary engineering work already accomplished by the member firms under previous contractual arrangements the structure reflects the experience of those directly associated with that work and not the theories of a corporate entity new to the Project.

Figure VI-1 shows the established functional structure for the project. This organization is designed to accommodate the transition from three independent engineering efforts undertaken during preliminary design to a unified, coordinated effort which will meld the overall design into a system. It consists of a Project Director's office supported by a Management Board and six operating units.

B. Personnel Assignment and Administration

Personnel of each joint venture firm are assigned professional and technical responsibilities throughout the organization in accordance with their particular qualifications and experience.

Likewise, administrative support positions may be filled by personnel of any of the joint venture firms, such positions being allocated to provide equitable participation.

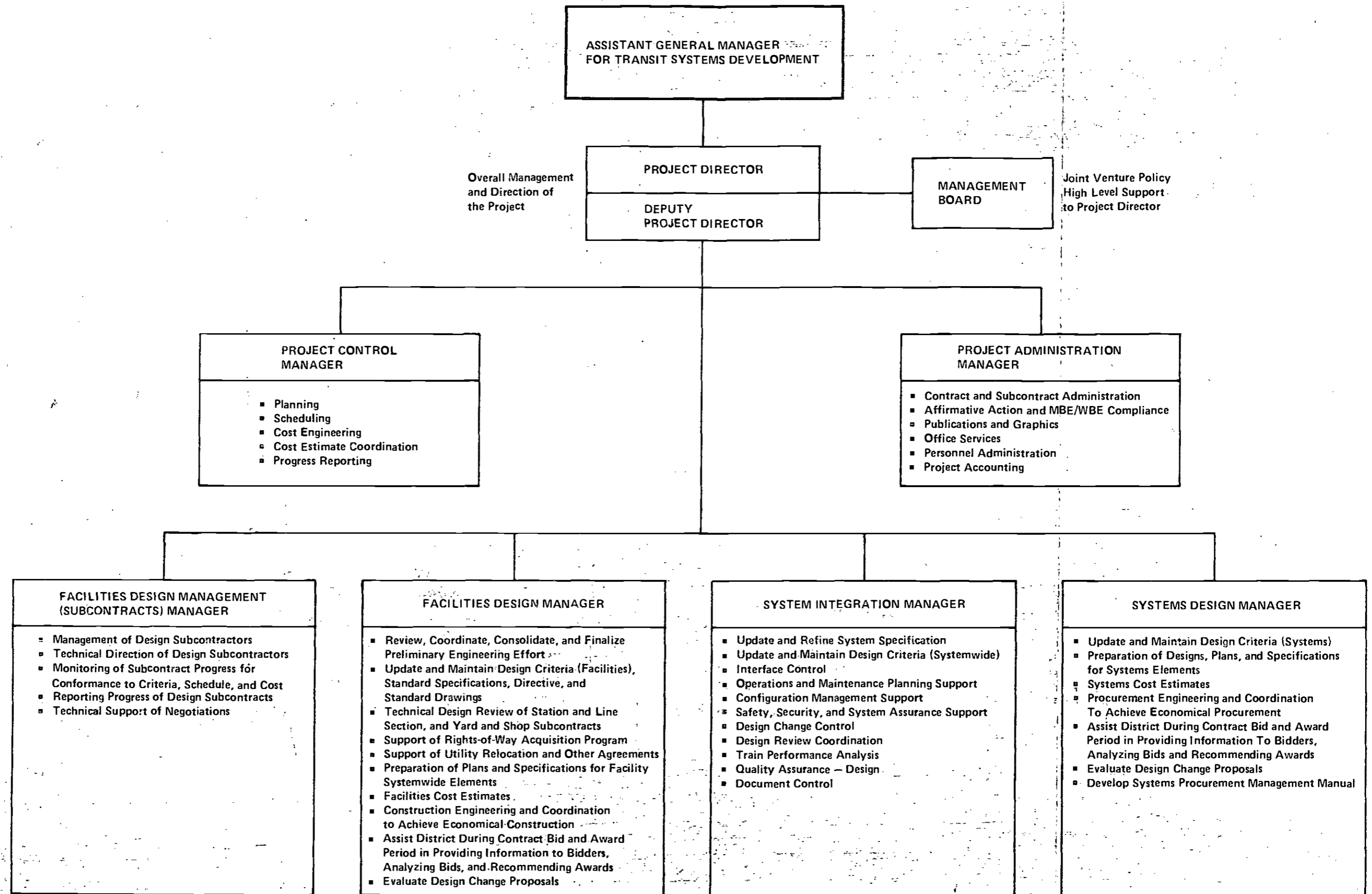


FIGURE VI-1
FUNCTIONAL STRUCTURE

Although all personnel assigned to the project remain on the pay-rolls of the individual firms, they function both administratively and technically under the direction of their MRTC organizational supervisors, regardless of firm affiliation. Administrative direction includes assignment of work space and equipment, approval of vacation schedules, sick leave or other excused absence, approval of time cards or time sheets, authorization of overtime work, performance evaluation and recommendations through organizational channels to the Project Director for personnel actions such as promotions, transfers and salary adjustments. Technical direction includes the assignment of work, monitoring of performance and approval of work output.

C. Project Director

The Project Director is responsible for managing the operation of MRTC through the six operating units headed by the Manager, System Design; the Manager, Facilities Design; the Manager, Facilities Design Management; the Manager, System Integration; the Manager, Project Administration; and the Manager, Project Control. The first four units are line functions and the latter two are administrative and control functions. The Project Director is supported by the Deputy Project Director who will in general, be responsible for day-to-day operations and coordination of the G.C. technical staff.

D. Management Board

General management of the business affairs of the joint venture is

vested in a Management Board composed of a principal of each of the firms. The Management Board establishes broad policies to attain joint venture and SCRTD objectives, allocates participation by the four firms and manages all financial and business affairs of the joint venture. The Management Board also supports the Project Director by providing top level advice and guidance in managerial, administrative and technical areas.

E. Engineering and Architecture

The engineering and architectural services are performed partly by the G.C. itself and partly by others under direction of the G.C. The three major design groups within the G.C., Facilities Design Management (subcontracts), Facilities Design, and Systems Design, are structured to address these different ways of delivering the services, and to reflect the differing methods customarily used to design equipment to be procured from manufacturers versus facilities to be constructed in place.

Facilities Design will be performed largely by subcontractors to the G.C. who are selected by the SCRTD Board of Directors. Direction of these subcontractor efforts is the responsibility of the Manager, Facilities Design Management.

Certain systemwide elements which are common to stations and guideways, such as elevators, escalators, ventilation systems, graphics and signing and trackwork will be designed by the G.C. under direction of the Manager, Facilities Design.

The major systems hardware will be designed by the G.C. under direction of the Manager, Systems Design.

1. Facilities Design Management

Facilities Design Management Division is staffed with Project Managers, carefully selected for their relevant skills and experience, who are assigned to direct and monitor subcontractor efforts for each facility design package.

Each Project Manager is responsible for meeting the established project goals for his design unit. Included is the preparation of work scope, obtaining refined estimates and schedules for the design effort and construction cost target, and conduct of negotiations with the subcontractor.

Upon satisfactory completion of negotiations, the assigned Project Manager then becomes the subcontractor's primary point of contact during performance of the design services. The Project Manager guides the subcontractor through the design process by promptly furnishing information on the basis for design and other subcontractor inquiries, resolving conflicts, providing timely and accurate direction in regard to design policy and criteria matters, and clarifying issues which arise with regard to the design services and design interfaces.

The Project Manager is the day-to-day technical administra-

tor of his assigned subcontract. He is responsible for ascertaining that all required G.C. actions are taken, and for monitoring progress and performance of the subcontractor by continuously reviewing and evaluating work for conformance to criteria, schedule and cost. He maintains all records and correspondence files pertaining to his project, chairs all technical meetings involving the design effort, is responsible for the orderly handling of scheduled submittals and the conduct of design reviews, and records and communicates all relevant information to other functional entities of MRTC, SCRTD, the Subcontractor and affected agencies.

The Project Manager provides MRTC management with appropriate reports on the performance, progress and problem areas relating to his assignment.

2. Facilities Design

The Facilities Design Division is organized into three sub-groups: Engineering, Architecture, and Right-of-Way/Agency Agreements.

Engineering

The Engineering sub-group, headed by the Chief Engineer, is comprised of engineers and technicians in the following disciplines: Civil, Structural, Electrical, Mechanical, Utilities, Trackwork, Specifications, Geotechnical, and Construction. Separately and/or in combination, members of this group will perform the following activities:

- o Review, confirm, consolidate and publish those facilities design criteria produced during the Preliminary Engineering Phase which cover all engineering disciplines involved in the Continuing Preliminary Engineering work.

- o Review, refine and update standard specifications for the materials and performance activities pertaining to the construction of the line segments, stations, yards and shops of the Metro Rail Project.

- o Review, confirm, coordinate and print the engineering-related standard and directive drawings produced during the Preliminary Engineering Phase which are relevant for use by the GC Subcontractor firms and equipment suppliers in the preparation of their project drawings. Produce additional standard and directive drawings deemed useful.

- o Review, confirm, consolidate and publish the criteria for project drawings.

- o Manage, coordinate, review and integrate the ongoing engineering-related work of selected special consultants; identify any overlaps or mismatches and make recommendations to the SCRTD for revision to their

scopes of services. Review the specific recommendations made by these consultants and determine that necessary decisions and policy inputs are made.

- o Perform design review of the prescribed engineering-related Milestone submittals from in-house design teams, design subcontractors and supplier firms. Review items of concern will be: conformance to established criteria; resolution of conflicts; verification of levels of completion; clarity of presentation; coordination between drawings and specifications and also among disciplines; acceptable engineering details; constructability; cost implications; sound engineering judgement.
- o Conduct value engineering analyses of the proposed designs and specification provisions on a continuing basis, using comparisons among subcontractor and supplier submittals, expert and industry advice, and GC in-house experience.
- o Develop technical procedures for guidance of the subcontractor firms toward their milestone submittals and for in-house use for the review process of subcontractor submittals.

- o Prepare drawings and specifications for systemwide facility items including trackwork procurement, trackwork installation, ventilation facilities and other miscellaneous systemwide items.

- o Undertake Support Services and Special Analyses as required in response to specific requests from the SCRTD.

- o Review plans and specifications as they are being developed, and advise on the selection and availability of labor and time requirements for installation and construction costs.

- o Assist in development of construction contract packages taking into consideration such factors as the type and scope of work to be performed, time of performance, availability of labor and material, community relations and other pertinent criteria. Identify cost-effective opportunities for design/construct, design/fabricate/install, and joint or follow-up procurement of materials, equipment, and subsystems.

- o Review plans and specifications for proper interfacing among contracts, to avoid overlapping jurisdictions which would produce conflicts between con-

tractors, and to assign all phases of the work to the proper construction contract.

- o Review specifications to determine that they contain provisions for the temporary facilities necessary to enable a contractor to perform his work, and provisions for all of the jobsite facilities necessary to enable the construction management personnel to perform their duties.

- o Assist the SCRTD, as requested, in the conduct of pre-bid conferences to inform prospective contractors of requirements, and assist the SCRTD, as requested, in the evaluation of the capability and professional competence of prospective construction contractors, conduct bid meetings, review abstracts and tabulation of bids received and make recommendations for award to the SCRTD.

- o Provide assistance in the analysis of Value Engineering proposals.

- o Coordinate and cooperate with the SCRTD's Construction Manager to evaluate proposed design changes necessitated by conditions revealed

during construction. Arrange for and process all design changes to the plans and specifications. Arrange for and coordinate the on-site visits by and assistance of the GC design engineering staff whenever required or requested by the SCRTD or the Construction Manager.

Architecture

The architecture sub-group, headed by the Chief Architect, is comprised of architects and technicians who will perform the following activities.

- o Review, confirm and consolidate those station-related facilities design criteria produced during the Preliminary Engineering Phase which cover all disciplines involved in the Continuing Preliminary Engineering Work.

- o Review, confirm, coordinate and print the standard and directive drawings produced during the Preliminary Engineering Phase which are relevant for use by the GC Subcontractor firms and equipment suppliers in the preparation of their project drawings. Produce additional standard and directive drawings deemed useful.

- o Manage, coordinate, review and integrate the on-going station-related work of selected special consultants; identify any overlaps or mismatches and make recommendations to the District for revision to their scopes of services. Review the specific recommendations made by these consultants and determine that necessary decisions and policy inputs are made.

- o Perform design reviews of the prescribed station architectural-related Milestone submittals from in-house design firms, Design Subcontractors and supplier firms. Review items of concern will be: conformance to established criteria; resolution of conflicts; verification of levels of completion; clarity of presentation; coordination between drawings and specifications and also among disciplines; acceptable architectural details; constructability; cost implications sound architectural judgement.

- o Prepare drawings and specifications for systemwide facility items including graphics and signing, the central control facility, station attendants' booths,

escalators and elevators, and other miscellaneous systemwide items.

- o Undertake Support Services and Special Analyses as required in response to specific requests from the SCRTD.

Right-of-way and Agreements

The Right-of-way and Agreements sub-group, headed by a chief, is comprised of specialists in real estate, surveying, agency agreement development and joint development who will perform the following activities:

- o Assist the SCRTD staff in right-of-way acquisition by establishing uniform procedures whereby design entities may certify right-of-way requirements, including definition of the type of space occupancy desired and any apparent necessary relocations.
- o Support the SCRTD in its property acquisition and relocation activities, including preparation of parcel descriptions, court exhibits and other materials and services which may be required for condemnation proceedings.

- o Support the SCRTD, as required, in its evaluation of Joint Development opportunities, and in its negotiations with potential developers.

- o Identify the needs for agreements between the SCRTD and other public and quasi-public agencies by which changes to the existing structures and facilities of others may be accomplished, as required for the construction of Metro Rail facilities.

- o Provide technical support to the SCRTD in the preparation of master agreements between the SCRTD and major City, railroad and utility entities, establishing the general terms of cost expenditure for design and relocation or reconstruction, treatment of betterments, credit for salvage, provisions for service interruptions and other related matters.

- o Monitor all surveying activities on behalf of MRTC and SCRTD.

- o Draft site-specific criteria and specifications for agreements for revision, relocation, reconstruction, restoration and abandonment of existing City, railroad and utility structures and facilities; define

the apparent relocation requirements.

- o Provide technical support to the SCRTD in its negotiation of master agreements and site specific agreements.

3. Systems Design

The Manager, Systems Design, is responsible for the design and specification of the majority of systems hardware elements, procurement engineering, and coordination to achieve economical procurement and such support to SCRTD as may be required in the awarding of contracts for systems equipment and installation.

The primary equipment items consist of the rapid transit passenger vehicles, auxiliary vehicles, automatic train control and communications systems, traction power and auxiliary power systems, fare collection system, ventilation and other electrical and mechanical equipment. These systems differ from constructed facilities in that, with the exception of the traction power installation, final design is shared by MRTC and the equipment manufacturers.

The Systems Design Division is organized into three functions: Equipment Engineering, Procurement Engineering and Design Control.

Equipment Engineering

The Equipment Engineering function is divided into two subgroups, Systems Engineering and Vehicle Engineering. The Systems Engineering subgroup, headed by an Assistant Project Manager, is comprised of engineers and technicians in the following disciplines: Communications, Automatic Train Control, Traction Power, and Auxiliary Power. The Vehicle Engineering sub-group, also headed by an Assistant Project Manager, is comprised of engineers and technicians in the following disciplines: Passenger Vehicles, Auxiliary Vehicles, Fare Collection, and Miscellaneous Electrical and Mechanical Systems. Both Assistant Project Managers Report directly to the Manager, Systems Design. Separately and/or in combination members of these sub-groups will perform the following activities.

- o Review, confirm, consolidate and publish the Systems Design Criteria.

- o Review, refine and update standard specifications for the material and performance pertaining to system engineering and vehicle engineering.

- o Review, confirm, coordinate and print the Systems Engineering related standard and directive drawings.

- o Review, confirm, coordinate and publish system descriptions. These descriptions will include functional/performance requirements and identification of interfaces with other Divisions and other system elements. The level of detail in each of the system descriptions will be such as to assist in the preparation of estimates and the preparation of drawings and specifications.
- o Provide input for cost estimating which is planned to be done at 60% and 85% completion of engineering.
- o Review and comment on the drawings prepared by other Divisions, subcontractors, and vendors.
- o Prepare equipment procurement contract documents for the detailed design, fabrication, and, as required, installation of system equipment. This will include Contract packaging, selection of potential bidders and identification of budget and schedule constraints.
- o Coordinate all engineering activities with SCRTD counterpart and provide assistance to SCRTD on request.

Procurement Engineering

This group, headed by an Assistant Project Manager, is

responsible for providing the procurement engineering support for all equipment items. In joint collaboration with the engineering staff, the group will perform the following engineering activities;

- o Develop and maintain a Procurement Management manual. Identify all the SCRTD and MRTC responsibilities.

- o Review plans and specifications as they are being developed, and advise on the selection and availability of materials and availability of labor and time requirements for manufacture and installation.

- o Recommend procurement and expedite delivery of long-lead-time items of machinery, equipment, materials, and supplies needed for the project so that delivery is compatible with project schedule requirements. Make recommendations to SCRTD for transfer of such items to contractors and installers where applicable.

- o Assist in development of procurement and installation contract packages taking into consideration such factors as the type and scope of work to be performed, time of performance, availability of labor and material, and other possible constraints. Identify cost-effective opportunities for design/construct, design/

fabricate/install, and joint or follow-up procurement of materials, equipment, and subsystems.

- o Review plans and specifications (1) for proper interfacing among contracts, (2) to avoid overlapping jurisdictions which would produce conflicts between manufacturers and between installers and (3) to assign all phases of the work to the proper contract.

- o Review specifications to determine that they contain (1) provisions for the temporary facilities necessary to enable an installation contractor to perform his work, and (2) provisions for all of the jobsite facilities necessary to enable the procurement management personnel to perform their duties.

- o Assist SCRTD, as requested, in the conduct of pre-bid conferences to inform prospective contractors of requirements, and in the evaluation of the capability and professional competence of prospective procurement and installation contractors. Conduct bid meetings, review abstracts and tabulation of bids received and make recommendations.

- o Provide assistance in the analysis of Value Engineering proposals.

Design Control

The design control subgroup, headed by the Assistant Project Manager, Controls, is comprised of drafting, secretarial and office staff that provide production and assistance to the Manager, Systems Design. Separately and/or in combination, members of this group will perform the following activities:

- o Keep Systems Design Manager informed on project progress and problem areas related to cost and schedule through maintenance of appropriate records and data.
- o Provide input to the Monthly Progress Report, Cost and Comparison Report, and project schedule.
- o Prepare priority lists of drawings and assign adequate drafting staff to ensure completion of drawings within schedule constraints.
- o Monitor action items and ensure timely resolution and response.
- o Monitor requirements for Systems Division deliverables including completion schedules.
- o Supervise interface between document production group and Equipment Engineering.

- o Prepare milestone summary reports.
- o Prepare and maintain Systems Design Procedure Manual.
- o Organize and supervise the Division's conformance to centralized document control procedures.

F. System Integration

The System Integration Division is organized into four sub-groups: Interface Control, Configuration Management, Safety, Security and Assurance, and Operations and Maintenance Planning.

Interface Control

The Interface Control group, headed by a Supervisor - Interface Control is comprised of Interface Engineers, Architects, and support staff. Separately and/or in combination members of this group will perform the following functions:

- o Develop procedures for identifying and controlling contract-unit-oriented physical and functional interfaces
- o Assist management in identifying contractual interfaces and delineating internal areas of responsibility
- o Prepare plan and procedures material for inclusion into the Configuration Management Plan

- o Coordinate publishing of Design Criteria as baseline release
- o Update System Specification
- o Support the identification and definition of policy-level technical issues with major impact on design of system elements and interfaces
- o Participate in project design review to insure compliance to criteria and other applicable baseline documents and control of interfaces
- o Organize and/or participate in task force approach to resolution of major interfaces, e.g., clearance, exiting
- o Perform special analysis related to interfaces as required

Configuration Management

The Configuration Management group, headed by a Supervisor - Configuration Management, is comprised of a Change Control Engineer, Document Control Clerks and support staff. The group will perform the following functions:

- o Ascertain that Configuration Control requirements are included in each design, procurement, or installation contract.

- o Prepare a Configuration Management Plan including detailed procedures of operation.
- o Establish and maintain a Document Control Center.
- o Establish a definition of a Design Baseline and control the configuration of this baseline.
- o Implement and administer a Policy Design Directive and a Change Request procedure.
- o Draft and provide administrative support to a Design Review Procedure.
- o Provide support to other project groups as requested.

Safety, Security and Assurance

The Safety, Security and Assurance group, headed by a Supervisor - Safety, Security and Assurance, is comprised of engineers and specialists in the disciplines of:

- o Systems Safety
- o Fire/Life Safety
- o Reliability
- o Maintainability
- o Human Factors

- o Testing
- o Security

The group will perform the following functions:

- o Develop Program Plans for Safety Assurance, Security, Quality Assurance, and Safety Certification.
- o Develop design criteria relating to these disciplines.
- o Monitor the design for compliance to criteria.
- o Participate in Fire/Life Safety and Security Committee meetings.
- o Prepare an Integrated Test Plan.
- o Perform special studies as required.
- o Assist in preparation of design procurement and/or installation contract specification material relating to these disciplines.

Operations and Maintenance Planning

This group, headed by a Supervisor - Operations and Maintenance Planning, will consist of Engineers and Specialists in operations and maintenance planning and will perform the following functions:

- o Prepare/refine/update Operations Plan
- o Perform analysis as required to support updating of Operations Plan. This will include train simulation models for trip times, station locations, alignments, failure recovery, and other related issues.
- o Complete development of Maintenance Plan
- o Develop O&M cost estimates
- o Participate in design reviews for adherence to operations and maintenance requirements and/or design practice
- o Provide operations and maintenance design support as requested
- o Assist in development of training and manual requirements for procurement, install or construction contracts
- o Develop maintenance data system for system operation phase

G. Project Administration

The Manager, Project Administration is responsible for providing administrative support to all technical functions of the G.C. The Project Administration Division is organized in two sub-groups:

Contracts Administration and Human Resources. The accounting function reports directly to the Division Manager.

Contracts Administration

This sub-group, headed by a Deputy Manager of Administration for Contracts Administration, is responsible for the negotiation and administration of non-technical aspects of all subcontracts from award through close-out. The Contracts Administration sub-group prepares procurement packages, proposal requests and solicitations; reviews and evaluates proposals; and procures all professional services except those reserved by SCRTD. This sub-group schedules, and coordinates the preparation of manpower estimates for the negotiation of design fees; is responsible for coordination of pre-award meetings; and prepares pre- and post-award documentation.

Human Resources

This sub-group, headed by a Deputy Manager of Administration for Human Resources, provides and administers a wide range of services including personnel administration, recruitment, travel arrangements and employee relocation; affirmative action including EEO and MBE/WBE programs; centralized publication services including word processing, editing, graphics coordination and printing; and general office services including mail and courier service, purchasing, communications facilities and data processing.

The Division Manager's office includes the project accounting and financial records function; and acts as Secretary to the Management Board.

H. Project Control

The Project Control Division is organized into three sub-groups: Estimating, Scheduling and Cost Control. Together, these sub-groups will establish the baselines for costs and time, then control costs and schedules by monitoring progress and reporting all deviations from the baselines.

Estimating

The Estimating sub-group, headed by the Chief Estimator, is comprised of estimators and technicians who perform the following activities:

- o Prepare the Project Budget

- o Prepare Current Working Estimates (CWE) at each design control point for each design package. The CWE will include the cost of:
 - All engineering and supporting services related to planning and design
 - Engineering services during construction
 - System Procurement
 - Construction and Installation
 - Right-of-way and Relocation
 - Utility Relocation
 - Construction Management
 - SCRTD Management

- o Establish and monitor a Project Cost Trend Program

Scheduling

The Scheduling sub-group, headed by the Chief Scheduler, is comprised of schedulers and technicians who perform the following activities:

- o Develop and monitor the Master CPM Schedule
- o Develop and monitor the Master Bar Chart Schedule
- o Develop and Monitor the Design Master Schedule

These Project Schedules will include:

- Engineering Services
- Utility Relocation
- Procurement
- Construction
- System-wide Pre-review Testing
- Commencement of Revenue Operations

Cost Control

The Cost Control sub-group, headed by the Cost Control Engineer, is comprised of Cost Engineers and Technicians who perform the following activities:

- o Develop and publish the Monthly Progress Report. This report will cover:

- G.C. Activities
 - Subcontractor Activities
 - Special Consultant Activities
 - Required Action Items
 - Comparative Cost Data: Actual vs. Estimated
-
- o Develop and publish the Physical Progress Report which illustrates the actual, earned, and budgeted progress by design package.

 - o Monitor and evaluate escalation and contingency

 - o Coordinate and compile the draft Annual Work Program

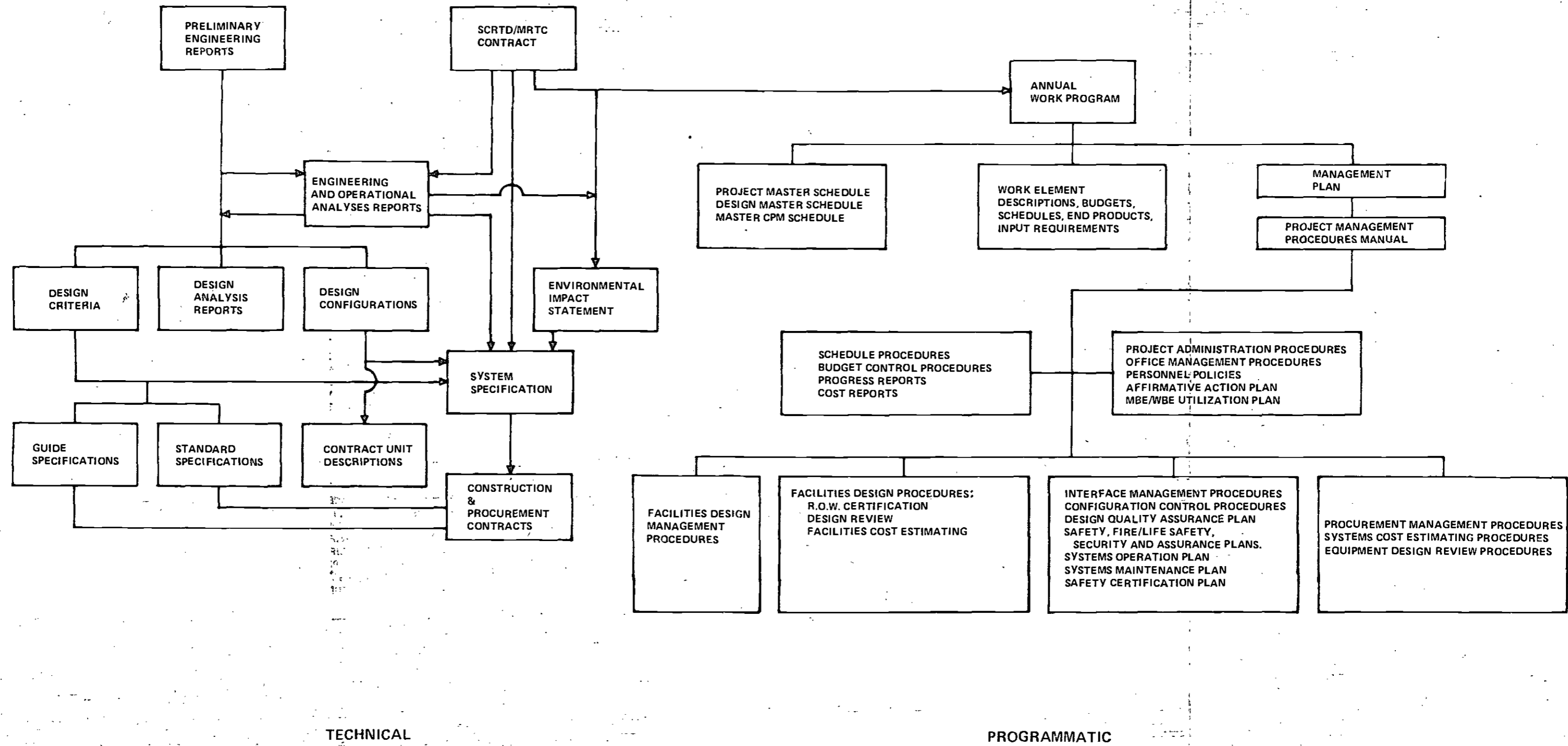


FIGURE VII-1
PROJECT DOCUMENTATION FRAMEWORK

VII. THE MANAGEMENT FRAMEWORK

The functional organization described in the preceding section provides the base for performance of the G.C. services in the form of integrated organizational elements with clearly defined functions. The lines of communication through which direction of the work is carried out are shown on the organizational chart. The MRTC managers have been carefully selected on the basis of capabilities for the work under their jurisdiction. What remains to be defined is the management method by which the work performed by the various elements is coordinated to produce an integrated system, and the means by which control is exercised over performance and quality of the work and over costs and schedules. A program with the scope and magnitude of the Metro Rail Project requires systematic management. Such is reflected in the formal documentation and procedural framework established to allow the integration and control function to be properly exercised.

A. Documentation

Figure VII-1 shows a schematic representation of the documentation framework for technical and programmatic aspects of the work undertaken by the G.C. The left-hand side of the chart shows the key technical documents and document types and indicates the development progression of these documents. The right-hand side of the chart shows the hierarchy of key programmatic documents used to plan, manage, control and execute the overall G.C. activities in accordance with the MRTC/SCRTD contract. Although not feasible to show on the figure, there is a constant interaction between the technical and programmatic aspects of the project with the effects

of such interaction and coordination being manifested in the documents themselves.

1. Technical Documentation

The technical documentation progression involves the use of a series of formal baseline documents which manifest the development of the system design, provide evidence of design continuity and integration and constitute the only official description of the integrated system. For each element of the system these baseline documents, signifying that a milestone of definition has been reached, are agreed upon by all cognizant individuals or agencies and may be used with confidence as the basis for subsequent activities. Upon establishment of the Project Design Baseline, baseline document can be changed, but such changes must be more rigorously reviewed and documented (the Configuration Control process) than a change which does not affect a baseline document.

The five primary baselines are:

- o Project Requirements Baseline - This baseline is defined by documents produced during the Preliminary Engineering Phase. They consist of Preliminary Engineering Reports which evaluated various system and alignment alternatives; and engineering and operational analysis reports which formed the basis for the design criteria. These reports, in total, formed the basis for the conceptual design upon which the initial cost estimates and project schedules

were developed. This basis includes the engineering and operational requirements for design of facilities, systems and architecture.

- o Project Design Baseline - This baseline is the final basis for design, represented by the System Specification, design analysis reports, final design criteria (a compendium of five volumes covering System-wide Design, Station Design, Civil/Structural Design, Mechanical/Electrical Design, and Subsystems Design), and design configurations (general plans, standard drawings and directive drawings). The Project Design Baseline is further summarized in the System Specification which reflects the design decisions as they are made. The System Specification, together with the design configurations, describes in detail what system is to be built. Design analysis reports document decisions underlying the project design baseline and therefore constitute a description of why the design is the way it is. The final design criteria are revisions and supplements to the criteria developed during preliminary engineering and describe how the system is to be built. The System Specification, design configurations and final design criteria all reflect the revisions to the original basis for design. As final design proceeds, revisions to these documents.

will continue to be made. The project design baseline is the final systemwide baseline: all subsequent baselines will apply specifically to individual contract packages.

- o Function Baselines - These baselines are developed specifically for each contract package. They correspond to Design Control Point Number 2 as defined in the MRTG/SCRTD contract. For equipment contracts, where the equipment manufacturer designs the equipment based on a combination performance/detailed specification, these baselines are represented by conformed bid documents.

- o Contract Design Baseline - These baselines correspond to Design Control Point Number 4. For construction contracts these are the construction bid packages. For equipment contracts, they generally consist of the approved vendor design drawings on which the manufacture of the equipment is based.

- o Acceptance Baseline - These occur at the points at which the SCRTD accepts the constructed or installed products. They are documented by the conformed as-built drawings for the system element, and except for warranty and related reliability verification act-

ivities, represent the end of the work of the contractors and designers.

2. Programmatic Documentation

The programmatic documentation framework is headed by the Annual Work Program. This document is prepared annually and is the program of work to be undertaken in the next fiscal year as mutually agreed by MRTC and SCRTD. The Annual Work Program contains a copy of the Program Master Schedule in bar chart form, identifies and describes all work to be performed by the G.C. in the fiscal year as necessary to support that schedule, and documents established cost estimates and ceilings, cash flow requirements and fees for that work. The work performed is categorized into one of nine primary areas of services (Project Management, Project Administration, Project Control, Facilities Design Management, Facilities Design, System Integration, Systems Design, Design Subcontracts, and Special Consultants) in the Annual Work Program. The Annual Work Program also provides a record of cumulative costs incurred and estimated percentage completion of the various work items.

Because the Annual Work Program represents the agreed baseline for all work to be performed by the G.C. in a given fiscal year, it necessarily governs all programmatic activities. The work items contained in the document, supplemented by procedures and working level plans specific to

given functional areas of the G.C. activities, provide all of the technical and programmatic documentation. This Project Management Plan document, along with all of the other plans, schedules, reports and manuals shown in Figure VII-1, have been generated in response to the needs of the G.C. activities as dictated by the SCRTD/MRTC contract, the Annual Work Program and the foregoing descriptions of G.C. roles, responsibilities and management tasks.

Of particular importance in the programmatic documentation are the overall program schedule and budget. The budget, cost and schedule documents utilized are designed to provide visibility of the past, present and future activities and events associated with the activities and events. This documentation represents one of the most crucial data sets required for management of the program and G.C. activities.

B. Procedural Framework

Management of the many G.C. activities requires the use of procedures to be followed by all personnel. These procedures are not designed to restrict the initiative, ability or development of G.C. personnel but are designed to provide for proper control of G.C. activities through the use of well reasoned and consistently applied methods and processes.

1. The Project Management Procedures Manual represents the top level procedural document and contains specific direction for all functional elements of the G.C. organization for planning and accomplishment of the work required by the Annual Work Program. The Project Management Procedures Manual also directly reflects the roles, responsibilities, tasks, functions, documentation, and prerogatives described in this Project Management Plan. The Project Management Procedures Manual also contains specific procedures for implementation of Facilities Design Management, Facilities Design, Project Administration, Office Management, Scheduling, Estimating, Budget Control, Cost Control, Interface Management, Configuration Control, Design Services and Procurement Management. Also included in the Manual is the Personnel Policies and Procedures Manual. For design, Design Procedures Manuals establish minimum requirements, procedures and standards governing all detail design work, whether performed by subcontractors or MRTC. It prescribes procedures and standards for planning and controlling the design efforts and for preparing, checking and approving engineering calculations, drawings, cost estimates and other project documents. It also assigns responsibilities for these functions. Appendix 1 shows an outline of the Project Management Procedures Manual and, as can be seen, many aspects of project activities are covered. The Manual is essentially a "living" compendium of individual

procedures, plans and manuals which will be added to and revised, as necessary, during the course of the Project.

2. In many cases, the Project Management Plan or related procedures require the formulation of approach development, and implementation of plans and procedures to be contained in other documents (see Figure VII-I). Such is the case in the Affirmative Action area where specific Affirmative Action and Minority Business Enterprise Utilization Programs are required these Programs, in turn, develop the specific requirements for G.C. Affirmative Action activities including regular reporting of Affirmative Action related data.

Many of the Project Management Procedures require the development of plans and/or manuals identifying specific program requirements and/or detailed procedures to be followed. In the Quality Assurance area, the top level Project Quality Assurance Plan identifies design quality assurance requirements. The Plan describes control procedures and responsibilities for implementing the Quality Assurance and Control Program required by the Project Quality Assurance Plan and covering the design phase of the Rapid Transit Program.

Similarly, there are program plan requirements for Configuration Control, Interface Management, Safety, Fire/Life Safety, Security, and Systems Assurance. Outlines or tables of contents for these Plans will appear in the Appendix.

C. Performance Monitoring and Control

1. Annual Work Program

Prior to commencement of each fiscal year, an Annual Work Program is prepared by MRTC in which the type of work, responsible functional unit, proposed scope and detailed description, cost, schedule, and end products are identified. This Annual Work Program, when approved by SCRTD, becomes the basis for monitoring progress and, when supplemented by the internal control procedures described herein, provides an effective control process over work performance by prescribing what work is to be done, how it is to be done and what products or deliverables are expected to result. It also assists in controlling schedule and costs as further described below.

2. Project Cost Control (G.C.)

Project cost control for the G.C. work is a continuing function performed by all department heads and monitored by the Manager, Project Control.

The basic process begins with the Annual Work Program which proposes a scope of work, schedule and cost ceiling for each element of work. This cost ceiling is determined initially by the manager responsible for the work element, based on his/her estimate of the manpower required to accomplish the task. After preparing of each element of the Annual Work Program, it is reviewed by the Project Control Division to determine that the scope conforms to the contract, and that the schedule and cost ceiling fall within the project master schedule and the overall engineering budget, respectively.

After review and approval of the Annual Work Program by project management and SCRTD, cost performance is monitored by the Project Control Division which receives cost information from accounting as costs are accrued and manpower utilization information from reports derived from individual time sheets. A report of costs and manpower utilization is furnished to the Division head or manager for each work element. The Division head or manager can thus keep track of costs and, by estimating the work remaining to be completed can determine if corrective action is required to keep his costs within the ceiling. Copies of the cost reports are also furnished to management so that overall cost performance can be reviewed.

3. Design Performance

As previously indicated, the quality assurance plan for the project embraces all aspects of the work and includes specific provisions for design reviews. This formal process is carried out by the cognizant design project managers for the system elements for which they are responsible. In the continuing preliminary and final design phases of the project, it consists of a four-cycle review of the design of each system element: a preliminary design review; an in-progress design review; a pre-final design review; and, a final design review. In this process, design documents at the four stages of development are distributed to all disciplines for review and analysis. Design review meetings are then held with all disciplines to discuss the designs and to resolve conflicts. Minutes are kept of each meeting (filed with Configuration Management) and unresolved items disclosed at the meeting are assigned to a specific individual for study or resolution. These items are then discussed and resolved at subsequent review meetings. These reviews involve the use of design control points in the MRTC/SCRTD contract. These control points consist of: scope statement for each design package at approximately the 30% level, a design development statement review at the 50 to 60 percent design level (informal on-the-board reviews at approximately the 40 percent design level will be made to assure that no major conflicts are developing)

a pre-final review at the 85 to 90 percent design level, and a final review at the 100 percent design completion level.

The Design Procedures Manual provides G.C. personnel and G.C. subcontractor personnel with specific direction for the preparation of engineering calculations, project drawings and contract specifications. The manual also covers drafting standards, checking and coordination requirements and cost estimate preparation requirements.

4. Change Control

The baseline documents previously described governed the early design work and served as the basis for design until they were changed or superseded. A procedure will be developed as a part of the Configuration Management Plan to provide a formally structured method for revising the basis for design, final design and contract documents. This procedure (previously referenced) establishes a process by which project managers, architects and engineers may initiate a request for revision using a standard format. This request is reviewed at three levels.

The first review level is performed by the appropriate project manager who determines the basic merit of the change and whether the change should receive further con-

sideration. By signing a formal change request notice, the project manager (through the Configuration Management sub-group) solicits statements of impacts from all technical departments of the G.C. The development of the impact statement constitutes the second level of review of the change and it is at this stage that the potential technical, cost and schedule effects of the change are analyzed and documented. The third and final level of G.C. review involves the Change Control Board. This board, appointed by the Project Director, includes the project managers and managers of other technical departments. The board meets on a regular basis to review individual change requests (and their documented impacts) and to approve/disapprove/modify the change requested. The Configuration Management, sub-group is responsible for covering the Change Control Board and for implementation of the Change Control process including official notification and documentation of any approved change.

5. Schedule Control

Schedule control begins with the Annual Work Program which establishes a scope of work, a schedule and a cost ceiling for each work element. The work element schedule is developed by the Project Manager or department head responsible for the work element, conforming to the overall project

schedule. The work element schedule is then reviewed by Project Control to assure its compliance with the Project Master Schedule.

The Project Master Schedule is composed of three elements: A Design Master Schedule in bar chart form covering all activities from engineering through construction to revenue service; and showing work element and contract package starting dates and durations; and a Master CPM Schedule, covering engineering, R.O.W. acquisitions, utility relocations, procurement, installation, construction, systemwide pre-revenue testing and revenue operation.

The bar chart schedules, which are easy to read and follow, are intended primarily for executive review of the entire program, and for review by lay persons outside of the project office. The CPM Schedule is a complex computerized arrow-and-node network which defines the sequences and interrelationships of the thousands of activities which will make up the schedule. It identifies the critical path through the network, any change of which will affect the overall completion date of the project. The CPM Schedule is intended for use by the scheduling group to establish the overall project completion date and the critical work elements which must be carefully monitored to ensure timely

completion. It is also utilized by project managers and engineers to establish time schedules for their work elements. The Master CPM Schedule will be updated at appropriate intervals.

The Design Master Schedule is updated quarterly to reflect schedule changes which are incorporated in the Master Bar Chart Schedule. Schedule compliance is reported in the monthly progress reports so that action to correct schedule slippages can be taken. Changes in the approved Design Master Schedule will only be made upon written approval of the SCRTD.

6. Project Staff Meetings

Day to day performance of the various G.C. functional units is reviewed and coordinated at weekly staff meetings held by the Project Director. Issues surfaced at these meetings are documented and action items (and responsibilities) listed in the minutes taken. Each meeting begins with a review of prior action items to verify completion of an item, resolution of an issue or progress towards such. These meetings cover all aspects of G.C. activities and are attended by the managers of the operating units reporting to the Project Director. A Management Board meeting, attended by the Project Director and other appropriate staff, will be held no less frequently than once a month to discuss any policy issues that may arise, as well as progress of the Project.

VIII. DELEGATIONS OF AUTHORITY

Authority to make decisions and to take independent action should, as a matter of principle, be commensurate with responsibilities assigned. For example, a project manager or manager responsible for the quality and accuracy of a given design should be authorized to give final approval to design documents. Generally speaking, authority to make decisions should be delegated to the lowest level of management at which responsible decisions can be made. Delegation of authority has at least three advantages: (1) it frequently expedites actions and permits decisions to be made in a timely manner; (2) it places authority in the hands of those who are probably the most knowledgeable of the details of the action; and (3) it relieves senior managers of the burden of handling the less important matters and allows them to concentrate on more important issues. On the other hand, delegation of authority carries with it the danger that the person to whom authority is delegated may not be aware of all of the ramifications or implications involved in his/her action or actions. The prerogatives of the senior managers to direct actions may be pre-empted by authority improperly exercised at lower levels.

To alleviate these problems, delegations of authority within the G.C. carry with them the responsibility that the person to whom authority is delegated keep higher and adjacent levels of management informed of decisions taken. This is normally done by furnishing copies of action documents to all of those on whom the action may impinge. This not only keeps higher levels of supervision and management informed, but also provides the opportunity for the senior manager to rescind the action in the event he/she is aware of circumstances not known to the approving

authority which make the action imprudent or improper.

The following are the delegations of authority to the Project Director and Project Managers currently in effect in MRTC. More detailed descriptions of responsibilities and authorities of other managers and supervisors are contained in the Project Management Procedures Manual, the Design Procedures Manual and the Personnel Policies and Procedures Manual.

A. General

The Project Director is authorized to represent the joint venture in all interfaces with the SCRTD and other outside agencies relating to performance of the project services in the project office. Exception: The Project Director is not authorized to negotiate or renegotiate the G.C. contract or amendments thereto. The Project Director may, however, participate in such negotiations as a member of the negotiating team.

The Project Director is required to keep the Management Board informed of all actions between the SCRTD and MRTC which are judged to be of interest to the Management Board. The Project Director, in turn, delegates to the project managers and all other managers the authority to interface informally with SCRTD staff on matters within their jurisdiction provided, however, that they make no commitments which may impinge on the activities of other managers or on the project as a whole.

The Deputy Project Director, under delegated authority from the Project Director, will act for the Project Director in his absence, supervise and coordinate inter-divisional activity with respect to the performance of services, make design decisions, as necessary, within design policy and established budgets, act as principal contact with SCRTD deputies to the Assistant General Manager, act as principal G.C. representative to joint SCRTD/G.C. non-policy making technical committees, and assume such other responsibilities as may be delegated to him under approved Project Management Procedures.

B. Personnel Actions

In accordance with the terms of the SCRTD/MRTC contract, the Project Director is authorized to approve, subject to personnel policies established for the project office, the recruitment, selection, hiring, removal from the services, transfer and adjustment of salaries of all project office personnel. Key personnel assignments and employee relocations are subject to further approval by SCRTD.

The policies and procedures governing personnel actions are contained in the Personnel Policies and Procedures Manual. This manual also assigns responsibilities and authorities for personnel actions to managers and supervisors.

C. Subcontracts

The Project Director is authorized to execute subcontracts with design firms and specialty consultants, subject to approval

by the SCRTD Assistant General Manager, Transit Systems Development. Specialty consultants may be selected either by SCRTD or by the G.C. Authority to negotiate all such subcontracts is delegated to Project Administration assisted by Facilities Design and/or Facilities Design Management in the technical aspects of each subcontract.

D. Purchasing

The Project Director has delegated authority for purchasing of materials and services to be used by the G.C. to the Project Administration Division. Purchasing is carried out by the Office Services sub-group, assisted by Contracts Administration in the procedural administrative functions.

E. Travel and Expense Accounts

The Project Director is authorized to approve all travel of G.C. employees. The Project Director is also authorized to approve all expense accounts. Division Managers are authorized to initiate travel request and to approve them subject to final approval by the Project Director.

F. Overtime

Overtime of G.C. employees may be authorized by Division Managers and approved by the Project Director subject to procedures developed by the G.C. and approved by the SCRTD.

G. Engineering Design

The design responsibility for each element of the system is delegated to an individual Project Manager. The Project Manager is responsible for all aspects of the design of his/her system element, for interfacing that system element with all others, and for meeting (through coordination with other departments) all system assurance, construction and procurement management, subcontract administration, specifications, project control, and configuration management requirements as such are manifested in contract documents.

H. Engineering Design Approval

The procedures for successive approvals of design documents by designers, checkers, chiefs of disciplines, subconsultant project managers and principals, and G.C. Project Managers and Division Managers are established in the Design Procedures Manual. Subject to concurrence of the Deputy Project Director, final approval of all engineering design documents by the G.C. is delegated to the Manager, Systems Design and Manager, Facilities Design within their respective fields.

IX. RELATIONSHIP TO THE SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT (SCRTD)

The G.C. exists only to fulfill the need of SCRTD and the roles and responsibilities such needs imply. Thus, control of the G.C. activities and the exercise of the G.C.'s responsibilities requires a well defined systematic, and yet flexible, relationship with the SCRTD. This relationship is formally manifested in the established methods of communication between the SCRTD and G.C. and is informally manifested in the myriad of daily contacts between SCRTD and G.C. personnel in the conduct of the program. The formal requirements of the G.C. are contained in the SCRTD/MRTC contract and specific correspondence mechanisms have been established to meet these requirements.

Formal correspondence between the G.C. and SCRTD is conducted at two levels. The first level involves direct written communication between the SCRTD Assistant General Manager, Transit Systems Development and the Project Director. This level encompasses all policy, administrative and contractual correspondence (except as noted below). The second level involves direct written communications by form letter or transmittal notice, between specifically delegated individuals within the SCRTD and G.C. organizations. This second level of communication is designed to expedite the transmission of regular, technical correspondence between the two organizations and is used for this purpose alone. Examples of regular technical correspondence include design control point submittals for SCRTD review and response and change request data for SCRTD review and approval/dissapproval.

All correspondence described above is to be numbered for control purposes

and copies are transmitted to a standard distribution list within SCRTD.
(See Project Management Procedure A.6.1 and A.6.2 for specific details).

X. CONCLUSION

This G.C. Project Management Plan provides an overview of the roles, responsibilities and management tasks of the G.C., and describes the organizational structure and documentation and procedural framework (including delegation of authority) established to fulfill these requirements. The plan concludes with a description of the mechanism developed for communicating with and responding to the needs of the SCRTD.

The design effort of the G.C. and its subcontractors is in its formative stages. As the work progresses, the activities of the G.C. may be modified to meet the needs of the program. Organizational structures may be revised, personnel may be reassigned to new positions within the overall organizations, and subcontracts will be completed. The management tasks may also change, but the basic mission for the G.C., the providing of all engineering and architectural services, contract preparation and administration, and authorized procurement management to fulfill the needs of the schedule for commencement of passenger carrying service, remains unchanged.

Project Management Procedures

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