Los Angeles County Metropolitan Transportation Authority

ARTHUR ANDERSEN

FINAL REPORT OF RECOMMENDATIONS

FOR

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VOLUME B
PART II

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PROJECT CONTROL - COST (COST CONTROL)

1.0 Nature of the Function

The term Project Control - Cost (Cost Control), as it is treated in this chapter, refers to the management of rail construction project costs for all phases of the project life cycle. Stated simply, the measure of cost control employed for a given rail project is the total cost growth incurred, relative to the original plan. Cost control takes on a specific meaning or meanings for the two principal phases of a rail project: design and construction.

1.1 Cost Control During Design

Cost Control during design includes control of the envisioned total cost, that is, the overall project scope and budget, the cost of professional design services from conceptual through final design, and the cost of owner-directed changes to the project, in both design costs and anticipated construction costs.

A primary goal of Cost Control during design is to ensure that station, tunnel, systems and other contracts are designed to the planned cost of construction. The MTA utilizes in-house and consulting estimating capabilities to review designs at specific milestones and determine the estimated cost to construct or procure and install the design. Another goal of Cost Control during design is to monitor the progress and fees of professional design services organizations like the EMC and Section Designers as they complete designs. MTA engineers review design progress with respect to design hours incurred to control these costs.

1.2 Cost Control During Construction

To support construction activities, the Cost Control function includes the activities of budgeting, cash flow management, commitment management and physical construction progress monitoring. Cost Control provides the MTA with the ability to monitor project budgets, commitments, forecasts, incurred costs and expenditures.

A fundamental aim of Cost Control during construction is to make complete and accurate cost information available for effective construction management. To be a true management tool, cost information must capture current construction costs and accurately forecast cost escalations due to potential contract changes and claims. It must provide a means for illustrating the amount of project budget committed to expenditures at a given time and forecast cash flow demands. A second aim is to track each Contractor's physical progress relative to expectations and prepare progress payments based on objective measurement. Another objective is to ensure that construction costs are contained and reduced through lessons learned and claims avoidance.

2.0 Issues of the Function

2.1 Fundamental Concepts

Cost Control is a cornerstone function of project management for a rail construction project. Thought of another way, the cost of a project forms one leg of a triangle representing critical project management trade-offs (see Exhibit 1). The cost of a project is influenced by the schedule held in place. In some instances, accelerating a schedule, particularly for complex design or construction work, will drive up costs. In other cases, lax scheduling or frequent schedule delays can have the same effect. Quality and cost have a similar relationship. While one can assert that superior quality will lead to lower total operations and maintenance costs; certainly as it relates to design- and construction- related project costs, higher quality drives up costs. The three parameters of cost, schedule and quality are intimately coupled. Stated differently, schedule and quality issues very quickly become cost issues. Safety, in this respect, is not a variable. Federal, state and local governments, not to mention basic consideration for human life, mandate certain levels of safety.

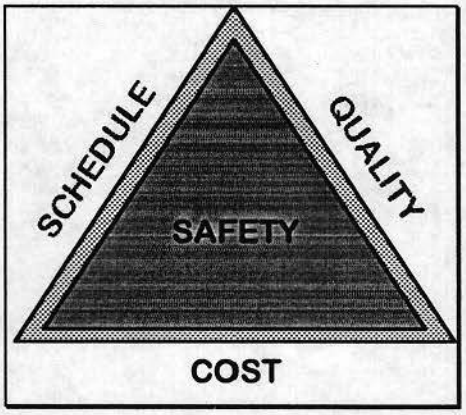


Exhibit 1

Cost control is important for a rail construction project because of its ramifications for the entire MTA rail construction program. Evidence of poor cost control on a given rail construction project will jeopardize the MTA's ability to fund future rail extensions. The MTA has delegated certain custodial responsibilities for managing federal, state and local funds to various consultants. Ultimately, however, the MTA, inclusive of elected officials comprising the MTA Board as well as the MTA staff, have full custodial responsibility for these public funds. It is the responsibility of the MTA Board and staff to demonstrate effective cost control discipline. To do otherwise seriously challenges the trust of funding entities and community tax payers.

An important aspect to consider is the varying effect of cost control depending on the stage of the project. It is possible to exert a far greater influence on total costs early in the project life cycle than late in construction. Fundamental decisions on the scope of the project, including the desired alignment, the number of stations, aesthetics and systems complexity made early in conceptual design profoundly influence the total cost of the project. Efforts to contain costs during final design or construction have reduced impact on the total cost of a rail project defined by earlier decisions.

Another important consideration is the effect of owner-directed changes introduced to the project. Again, the magnitude of any cost impacts from the change depends on the phase of the project. Early in Conceptual Design, the MTA can perform major alterations to the alignment, the number of stations, etc. and only incur the added staff and consultant costs required to prepare new sketches. Once the project design has proceeded through pre-final or final levels, changes grow costly due to the effort required to modify a large number of design drawings and specifications. If changes are introduced after construction begins, costs escalate dramatically as the contractor alters or reworks physical construction. Refer to Exhibit 2.

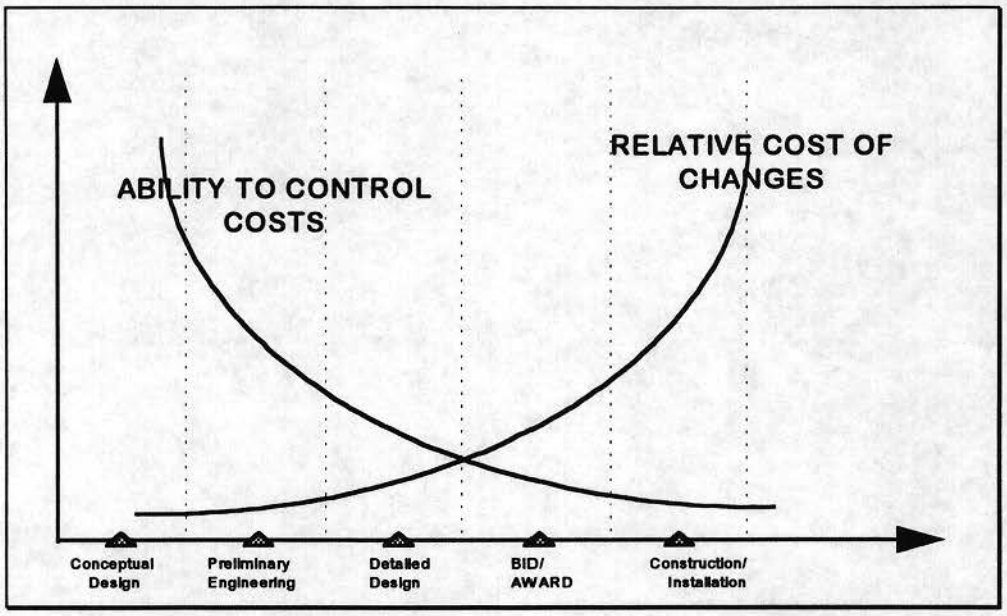


Exhibit 2

Generally, changes introduced after establishing the project budget and design direction have the following negative effects on cost control:

1. Costly rework: Designs may require substantial alteration or construction progress may be torn out to accommodate a change, all at a considerable cost
2. Schedule impacts: Disruptions to individual contract schedule changes may drive up total costs substantially
3. Competitive Disadvantages: If changes are not incorporated in the plans solicited for bid, the MTA loses the ability to realize a lower cost for the change through normal competitive bidding influences
4. Disruptive Control Environment: MTA staff oversees the efforts of design and construction consultants utilizing contracts based on a specific project plan. Whenever changes are introduced to the plan, MTA staff have a more difficult job of managing the efforts of consultants and controlling costs to the plan
5. Reputation for Change: By repeatedly introducing changes after contracts are established, the MTA develops a reputation for variability. Variability means risk to a potential MTA contractor or consultant, and this risk will be priced in bids the MTA receives
6. Demoralizing Effects: Due to the reduced cost control leverage late in the design or construction phase, as well as the costly effect of these changes, project staff may feel frustrated, ineffective or less willing to control costs.

2.2 Cost Control for Rail Construction Project Phases

The effectiveness of Cost Control depends on the management decisions made throughout each phase of the rail construction project:

Conceptual Design

Good Cost Control during Conceptual Design is achieved with the effective use of design resources. Were design and estimating resources chosen with program-wide experience and continuity? Are the Conceptual Designs under consideration feasible? Do they warrant an additional investment in Preliminary Engineering work? Many of these factors are determined within the MTA Planning and Programming organization. However, as was the case for MRL - Segment 3 and Pasadena Line projects, the Construction organization has had an increased involvement in Conceptual Design issues.

Cost Control for the entire project may be compromised even at this early stage by failing to utilize the lessons of past rail construction projects. More importantly, Cost Control is seriously degraded when a formal budget is adopted and fixed prematurely in Conceptual Design. At this point in the design, all of the risks and control requirements cannot possibly be identified and understood.

Preliminary Engineering

Cost Control during Preliminary Engineering implies controlling the progress and fees of the EMC to achieve a 30% design level, and ensuring that the rail system under design can be constructed for the target cost range defined in Conceptual Design. The EMC fees are controllable through solid design contracts with clearly delineated scopes, unambiguous mechanisms for gauging progress, and project concepts that remain stable throughout Preliminary Engineering. Managing Preliminary Engineering designs to target costs can be accomplished through reliable estimation and design reviews.

At the conclusion of Preliminary Engineering, a great deal is known about the overall project configuration and risk factors. Consequently, the entire Cost Control effort is greatly enhanced whenever the final budget, with determined contingency requirements, is adopted after Preliminary Engineering is complete.

Poor Cost Control during Preliminary Engineering results from ambiguous design services contracts that lack a detailed basis for determining progress. Conceptual designs which continue to change as Preliminary Engineering continues generates additional cost pressures. Inaccurate estimation or improper design reviews can allow designs to pass the Preliminary Engineering stage that will ultimately cost significantly more to build than the target called for. Also, inadequate environmental investigations performed during preliminary engineering can generate large costs.

Detailed Design

At the Detailed Design stage, Cost Control involves controlling the progress and fees of the EMC and all subcontracted Section Designers as they achieve a finished design. Once again, Cost Control for this phase includes ensuring that the rail system under design can be constructed for the target cost range defined at the conclusion of Preliminary Engineering. The designer fees are controllable through robust contracts with clearly delineated scopes, unambiguous mechanisms for gauging progress, and project concepts that remain stable throughout design. Managing detailed designs to target costs can be accomplished through reliable estimates and detailed reviews, both of which occur for each submittal milestone (In-process or 60% design completion, Pre-final or 85% completion and Final or 100% completion). Ambiguous design services contracts and frequent owner- or third party-requested changes to the design severely limit control over design services costs. Ineffective estimation or submittal review processes may result in higher than expected construction contractor bids.

Another Cost Control factor that enters during Detailed Design is the potential for a given contract design to allow future construction changes. Design errors and omissions are covered by an independent insurance agreement, while other design-related changes to construction contracts are best controlled early in the design through incorporation of "lessons learned" and detailed design reviews.

Construction

Cost Control during Construction focuses on minimizing the number and dollar value of construction and procure/install contract changes that are issued. Fees for Construction Management and EMC design support for construction are also cost elements to be managed. The number and magnitude of contract changes can be controlled to some extent by suitable change control management, including effective scrutiny, estimating and negotiating by the CM on the MTA's behalf. However, in the case of certain design- or owner-initiated changes, the point of effective cost control resides back in the design

process. No amount of diligent cost control during construction can make up for poor designs and specifications. Regardless, the MTA relies on accurate cost forecasts (developed by the CM for each contract) to spot potential problems and direct management attention. And as before, consulting fees are best controlled through precisely defined contracts, drafted in a climate of stability, that facilitate MTA evaluation.

Because changes during construction activities are typically the costliest changes to make, Cost Control during construction is very important. Stated another way, while the MTA may have a limited ability to improve the total cost picture for the project during Construction, lack of effective Cost Control during this late stage can have serious consequences.

2.3 Principal Cost Control Issues

The findings, implications and recommendations highlighted in the sections to follow are focused on what we believe to be the principle Cost Control issues facing the MTA for rail construction projects. These issues can be summarized as follows:

1. Organizational Roles and Responsibilities: The ability to control costs is influenced by the type of organization utilized by the MTA as well as assignment of responsibilities between MTA staff and consultants
2. Budget Adoption Process: Budgets that are well defined and based firmly on a well-developed preliminary design benefit cost control by providing realistic management objectives. Politically-motivated budget commitments or budgets adopted without proper knowledge of true project scope offer little support to cost containment
3. Project Contingency: Project contingencies allow the MTA to manage the project, with inherent risks, to the targeted cost. A proper assessment of risk factors limits surprises to MTA staff and the Board, and encourages rational management strategies. Insufficient contingencies create an environment of surprises and crisis management
4. Project Alterations: Based on the discussions earlier, changes to the project have significant effects on both the total cost and subsequent cost control capabilities
5. Control of Design Costs: Because of the complex nature of design products and the many engineering disciplines required for a rail design (architectural, civil, structural, electrical, mechanical, environmental, etc.), total designer expenditures are often challenging to control. The

ability to control these costs is influence largely by the quality of contracts executed and the stability of the design direction

6. Control of Construction Costs: Construction costs are controlled through sound, constructable designs that fully incorporate the requirements of the construction site, as well as by a sound change process approving only essential changes at the best negotiated price. Proper construction Cost Control depends on reliable, complete cost forecasting information alerting the MTA to potential problems.

3.0 Organizational Roles and Responsibilities

3.1 Findings Regarding Organizational Roles and Responsibilities

During design, the EMC develops, with final MTA approval, the budget, the cash flow plan and the commitment plan for each component contract and for the entire project. Responsibility for budget control, cash flow and commitment tracking and physical progress monitoring for the contract shifts from the EMC to the CM on a contract-by-contract basis after award. When the project transitions from design- to construction-dominated activity, and when responsibility for the Project Manager's Status Report shifts from the EMC to the CM, the CM takes control of the overall project budget, cash flow and commitment plans.

The overall responsibility to perform the tasks associated with the Project Control - Cost process resides with the CM. The MTA is responsible for the oversight of the CM as they perform the tasks associated with this process.

The following summarizes the major responsibilities performed by the CM Project Office organization, in priority order, as it relates to cost control:

1. Review scope, progress, changes, milestones, and work arounds for the project budget. The project budget includes all construction contracts, systems contracts, professional services contracts (i.e., the EMC and CM contracts), as well as the EMC design costs and fees
2. Originate Project Budget Change Requests (PBCRs) and submit to the MTA for approval when a change order results in: (1) contract cost exceeding the approved budget; (2) a claim settlement

results in a final cost exceeding the approved budget; (3) there are remaining funds at contract close-out or, (4) when the MTA, EMC or CM determine that actual costs will exceed the budget of project areas

3. Log all PBCRs and assign them a PBCR number to track their progress. Incorporate into the Project Budget and Project Schedule PBCRs approved by the MTA originating from the MTA and EMC, as well as from the CM
4. Update the Project Cash Flow Plan and the Project Commitment Plan. Provide in the Project Manager's Status Report and the monthly Cost Report a status of project cash flows and commitments, broken down by funding source (federal versus local). Perform a variance analysis and provide commentary for variances greater than 10% on a year-to-date cumulative basis for the entire project
5. Calculate and report on consolidated physical progress during construction. Develop and update a consolidated physical progress baseline for the project, which is used to track the status of construction activities
6. Perform an analysis of overall project contingency status

The following summarizes the major responsibilities performed by the CM Field Cost Engineering function, in priority order, as it relates to cost control:

1. Control the budgets for all construction and systems contracts
2. Track, update and forecast the status of cash flows for all construction and systems contracts. Receive the EMC-developed cash flow plan upon contract award and maintain throughout construction activities
3. Track, update and forecast the status of fund commitments for all construction and systems contracts. Receive the EMC-developed commitment plan upon contract award and maintain throughout construction activities
4. Measure percent complete, calculate and forecast physical progress. Establish physical progress measurement criteria to facilitate monthly updates. Develop and update a physical progress baseline for each construction and systems contract and submit to the MTA for approval. Assign and distribute cost factors to individual construction activities related to measurable physical progress
5. Identify prudent risk factors for potential contract cost escalation

6. Analyze and process monthly Contractor payment information. Maintain a computerized payment system
7. Review and analyze change documentation for accurate cost estimates

The following summarizes the major duties performed by the MTA organization, in priority order, as it relates to cost control:

1. Provide MTA policy directives determining the nature of cost information to be collected, the frequency of collection, the methodology for primary analysis and overall reporting requirements. Ensure that cost reporting is consistent in content and form with cost information being compiled for other projects within the Metro Rail program
2. Approve all Project Budget Change Requests (PBCRs) prior to incorporation into the project budget. Review PBCRs for compliance with FTA Circular 5010.1, Project Management Guidelines to Grantees
3. Approve physical progress baselines submitted by the CM including every construction and systems contract, as well as for the consolidated physical progress baseline submitted by the CM. Approve all changes to physical progress baselines
4. Summarize all contract actions into Authorization for Expenditure (AFE) documents
5. Collect cost information from each rail construction project into the Executive Report on Rail Program Status ("Gray Book")
6. Rate the CM ability to provide timely cost information, sound analysis, and effective contract management with the cost information given. Judge how well cost information is effectively utilized by the resident engineer in his fundamental role as construction contract administrator

3.2 Implications of Organizational Roles and Responsibilities

Each organization involved in a rail construction project possesses a project control staff. Every MTA project team contains a Project Control Manager, a Senior Cost Manager and a Senior Schedule Manager. Likewise, the EMC maintains project control staff to assist in the monitoring of design progress and generation of reports. The project CM maintains the largest project control staff consisting of lead cost and schedule analysts, field cost/schedulers and in-house reporting capabilities. (Note: Estimating capabilities are also present in each organization; however, please refer to Chapter IV, Volume B - Cost Estimating for additional details).

Due to construction management organizational changes, cost and schedule control positions were combined into one project control engineer function. In general, the project control engineers currently in place have a stronger schedule background than cost. Consequently, skill sets required to perform effective cost analysis in the field are still developing.

The MTA Project Control function within a project team consists of a Project Control Manager who is supported by a Senior Cost Manager and a Senior Schedule Manager as depicted in Exhibit 3. These individuals are responsible for the integrity of cost and schedule information on a project-wide basis. They rely on the project control resources of the CM as well as the EMC for detailed data acquisition and analysis.

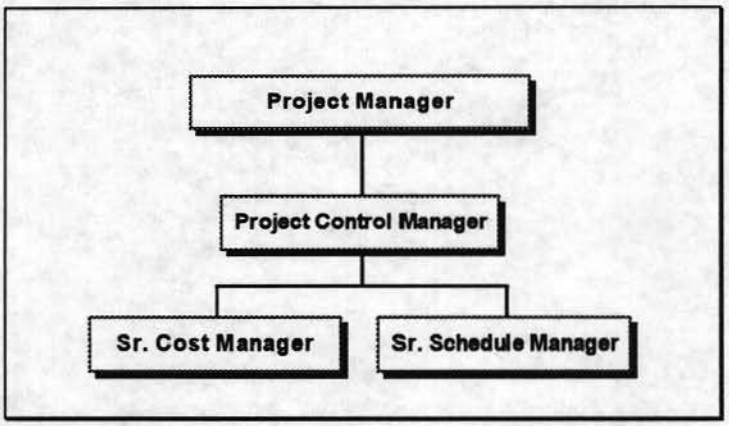


Exhibit 3. Current Project Control Organization

Five project control organizations could potentially be involved on the Red Line project; the project control groups of the MTA project team staff, the Segment 2 CM (Parsons-Dillingham), the Segment 3 - North Hollywood CM (if different from Parsons-Dillingham), the Segment 3 - Eastside and Segment 3 - Westside CMs. Each brings with it project control administration and report generating functions. The MTA Construction Director for Program Management has prepared an analysis of potential cost savings by consolidating the various project control groups. Specific recommendations regarding the report generating functions currently in place at the MTA, the EMC and the various CMs are outlined in detail in Chapter XII, Volume B - Project Control - Reporting and Management Reporting.

MTA project cost managers rely almost exclusively on the CM's project control staff to perform specific cost analyses. MTA project cost managers have not performed independent trend analysis and assessments of cost information to the level we believe is required for proper cost control oversight. In

addition, MTA project cost managers have not performed frequent independent audits of cost accumulation methods performed by the CM in the field.

3.3 Recommendations for Organizational Roles and Responsibilities

The MTA should develop a Project Control team for each project to be comprised of a selected group of individuals from the MTA, Construction Management Consulting firms, the EMC or other consultants. We propose a transitional organization structure with the Project Control Team reporting to an MTA Project Control Manager. The Project Control Manager should be supported by a Senior Cost Manager and a Senior Schedule Manager also mandated to be MTA employees. Refer to the transitional organization chart depicted in Exhibit 4.

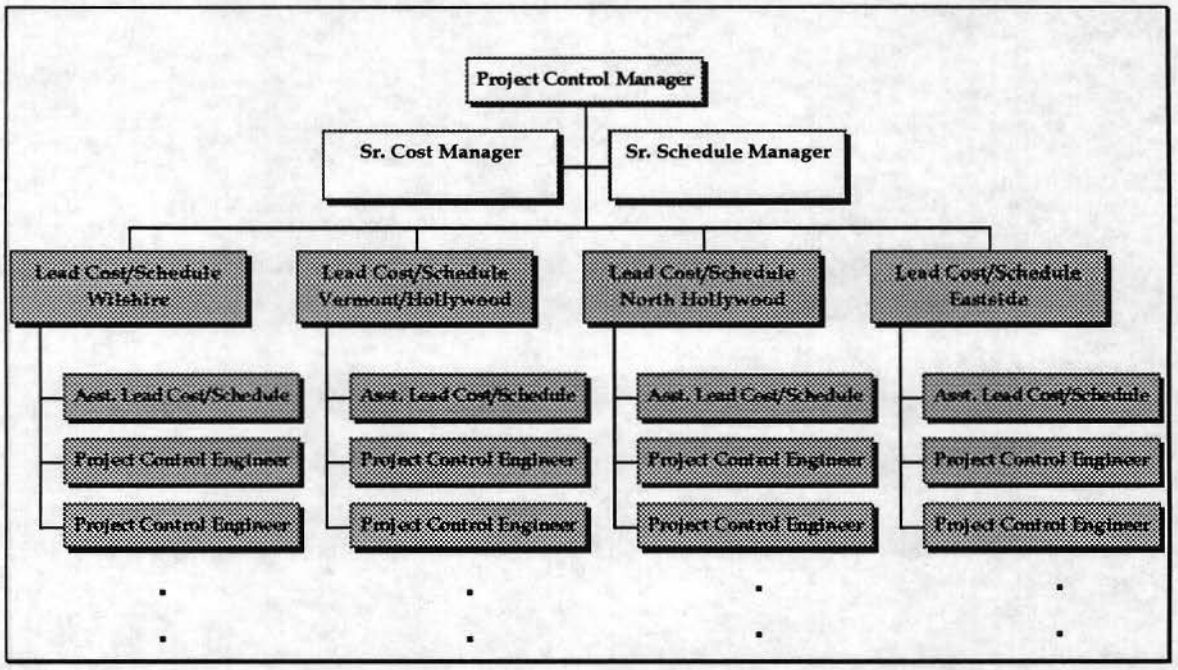


Exhibit 4. Recommended Transitional Project Controls Team Organization

The shaded boxes depict positions that should be filled from a pool of the best talent available from the MTA, the CM(s) and the EMC. Furthermore, establish a Project Control Committee to select Cost/Schedule Leads and Project Control Engineers. The committee should be comprised of the MTA Project Manager, the Project Control Manager, Senior Cost and Schedule managers, the Deputy Director of Program Management, the Project Managers from each CM and the EMC Project Control Manager. The Committee should select Cost/Schedule Leads early in the detailed design phase for early

acclimation to specific contracts prior to contract bid. As each contract is awarded, the Project Control Committee selects a Project Control Engineer from the pool of available talent for specific contract responsibilities.

Longer-term, we recommend that the MTA transition from the Project Control organization described above to an organization that fully integrates cost and schedule functions. This proposed organization is depicted in Exhibit 5. Here, the Senior Cost and Senior Schedule Managers become Senior Cost/Schedule Managers with a project corridor focus, rather than a project-wide functional focus. The dashed box surrounding the Wilshire Corridor segment indicates that, as construction activities diminish, project control personnel can be transitioned to the next corridor of heavy construction.

We also recommend that the MTA establish a project control reporting function within the Construction Division Program Management function. This MTA Project Control Reporting function should compile the relevant cost and schedule information into formal reports.

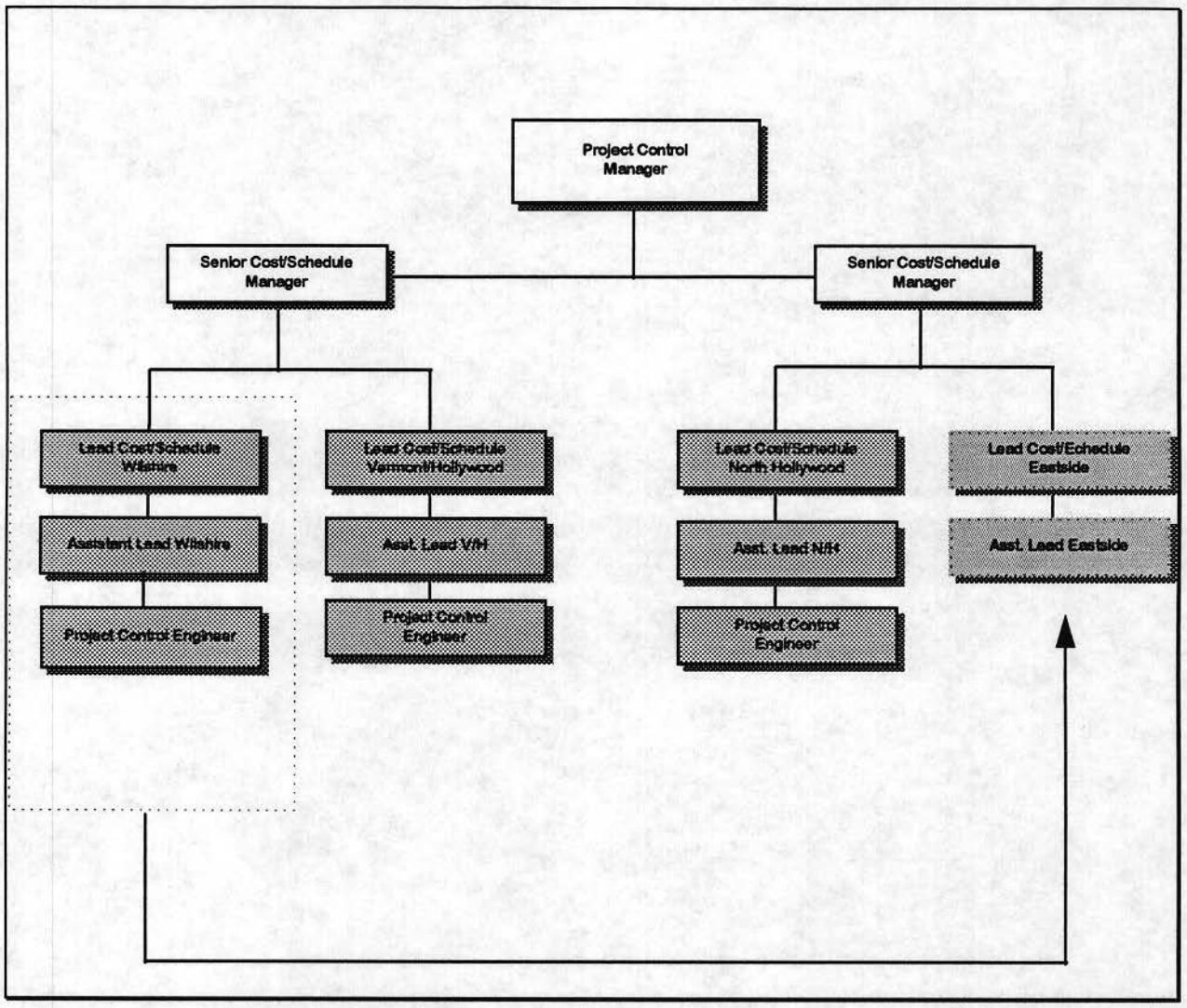


Exhibit 5 Recommended Future Project Control Organization

The MTA must also amend the CM scope of services to eliminate the requirement for a full project controls capability, but require that the CM provide quality candidates to fill available Project Control Engineer or Lead Cost/Schedule positions when requested by the Project Control Committee.

With these recommendations, we believe the MTA will obtain the following benefits:

1. Qualified Personnel: An ability to mandate qualified personnel are provided and available for this function
2. Time Flexibility: Flexibility to have budget, cash flow, commitment and physical progress information evaluated in a timely and cost effective manner

3. Staffing Flexibility: Less MTA staff limitations as cost control function demands increase (particularly during peak construction) compared to if the MTA were to take this function totally in-house
4. Improved Cost Control Oversight: MTA Senior Cost and Schedule Managers will assume a more active role in directing specific cost trend analyses and ensuring that program management methodologies are uniformly applied in the field
5. Better Cost Control Quality: Selecting the best available project control candidates from an inter-company pool will assure the MTA of obtaining the best skills for the required positions
6. Lower Costs: Eliminating redundancies in project control management will save the MTA in consulting fees and agency expenses
7. Enhanced Communications: By establishing an integrated multi-organizational, project focused team, potential organizational barriers to communication will be removed. More timely and candid project control information will likely result

4.0 Budget Adoption Process

4.1 Findings Regarding Budget Adoption Process

The Segment 2 project budget was established well prior to the completion of preliminary engineering (to 30% design completion). In fact, the project budget was developed under a set of assumptions that changed significantly before the project started. Not least among these assumptions were the overall alignment, owner preferences and the owner itself.

The Red Line Project, as originally conceived around 1980, consisted of an eighteen mile subway network with sixteen stations and an estimated total cost of $3 billion. Its original alignment extended west from downtown Los Angeles along Wilshire Boulevard to Fairfax, proceeded north along Fairfax to Sunset Boulevard, turned east again on Sunset to Cahuenga continuing to North Hollywood. Due to the limited funding available from the federal government, a "Minimum Operable Segment" (MOS) consisting of four rail miles and five stations at an estimated $1.25 billion cost was defined in 1983 to commence the project. The full-funding grant agreement establishing the MRL - Segment 1 (at the proposed $1.25 billion budget) was not signed until 1986.

Prior to signing the full funding grant agreement for MRL - Segment 1 in 1986, a series of events dictated a re-alignment of the Red Line network as originally conceived. The Ross Stores basement explosion on Fairfax Avenue and the subsequent definition of a "High Risk Zone" prevented tunneling activities to the west of Crenshaw Boulevard on Wilshire. While this had no material effect on the MRL - Segment 1 project, it required a complete alteration of the remaining Red Line path. The revised route split into two corridors at Wilshire and Vermont; proceeding north on Vermont and west on Hollywood Boulevard along one corridor, and west on Wilshire along the other corridor.

Based on this new alignment, the MRL - Segment 2 full funding grant agreement was signed in 1989 with an established project budget of $1.446 billion. The initial budget commitment provided for a 6.7 rail mile, eight station extension that also included portions of aerial track on Vermont and Sunset Boulevard. Hollywood community resistance to aerial trackwork drove the LACTC Board to mandate a completely underground alignment without changing the original $1.446 billion budget.

In 1987, the MRL - Segment 1 project budget was revised upward from $1.25 billion to $1.45 billion, motivating a series of cost control initiatives to drive down future rail construction costs for future projects. Proposed changes to MRL - Segment 2 included scaling back station designs and raising the tunnel profile for reduced station depths. Once again, the established $1.446 billion budget remained unaltered.

Based on lessons learned, the MRL - Segment 3 - North Hollywood and more significantly, MRL - Segment 3 - Eastside budget adoption processes differed from the past practices. Most significantly, the final budget was not adopted by the MTA Board until concluding Preliminary Engineering. The Segment 3 extensions also experienced alignment and systems definitions (track miles, rout and number of stations) that remained relatively unaltered from Conceptual Design to the conclusion of Preliminary Engineering and budget adoption.

4.2 Implications for the Budget Adoption Process

An adoption process that commits a rail construction project to plans, budgets and schedules based on assumptions with a high degree of uncertainty undermines the MTA's ability to control costs. Premature planning commitments open the door to significant design changes later (see Section 7.0, Control of Design Costs). Professional services contracts, including design services agreements, drafted in an unstable climate render scope and monitoring mechanisms obsolete. Hasty project adoption also

has negative implications for contingency, treated in greater detail below. In all, the MTA must reconcile its desire for cost control with political and other pressures driving toward an incomplete budget adoption process.

4.3 Recommendations for the Budget Adoption Process

The MTA should continue to refine its Project Adoption process which establishes a project budget and contingency only after concluding preliminary engineering. Require the involvement of each MTA discipline impacting the total cost of a rail construction project including Operations, Real Estate and Public Affairs. This can be accomplished when open communication channels exist between the MTA staff, Board and funding entities.

With this recommendation, we believe the MTA will obtain the following benefits:

1. Better Planning of Future Rail Projects: Greater fact-based management through risk factor analysis will provide future planning efforts with better information to accurately forecast costs for a given capability
2. Superior Cost Control: A more detailed accounting of contingency by risk factor will allow project management to effectively attribute cause and effect to cost escalations.
3. Enhanced Ability to Attract Funding: A higher level of certainty in the final cost of a proposed project will greatly aide the MTA's ability to attract future funding by lowering investment risks
4. Greater Program Credibility: With realistic design plans, budgets and schedules, the MTA can manage the rail construction program effectively and establish a responsible image to the public

5.0 Project Contingency

5.1 Findings Regarding Project Contingency

As outlined in the discussion above, the MTA practice of adopting a project budget has evolved over time. For MRL - Segment 2, the entire budget (with contingency) of $1.446 billion was established well in advance of conceptual design and preliminary engineering completion. In contrast, the MTA established the budget with contingencies for the Pasadena Line and, to an even greater extent, MRL -

Segment 3 - Eastside after the bulk of conceptual design and preliminary engineering had been completed.

Regardless of timing, the MTA has remained consistent with its practice of assigning overall project contingency at roughly 10% of each major budget item such as construction, professional services and real estate.

5.2 Implications of Project Contingency

Wherever uncertainty exists on a project, an element of risk is also present. The magnitude of risk is characterized by the likelihood of an outcome weighted by its impacts, typically costs. Project contingency is a tool to manage the level of risk, and is effective only to the extent that it is sized to those risks that are understood. Uncertainty, risk and contingency are intimately linked notions.

The more information the MTA has about a rail project the less uncertainty surrounds it. A conceptual idea possesses far more uncertainty than a design taken to 30% completion. The MTA improves its ability to identify and quantify project risks when preliminary engineering is complete. Therefore, the MTA can better establish the required level of contingency, and create a more realistic budget in the process, once preliminary engineering has concluded. This of course depends on the degree to which owner requirements are frozen at the conclusion of preliminary engineering. Unforeseen MTA-mandated changes to the project generate new risks which were unaccounted for in the original project contingency.

At another level of detail, the total project contingency should represent the sum of all individual contingencies addressing specific project risks. It is not appropriate to apply a uniform 10% contingency across the board to every budget item, and doing so removes information benefits gained through preliminary engineering. Despite the policy changes put in place for the Pasadena Line and MRL - Segment 3 - Eastside projects, the MTA still relies on a relatively unsophisticated methodology for determining contingency requirements.

Project contingency for MRL - Segment 2 was set before preliminary engineering and even before the conceptual design was finalized. Consequently, MRL - Segment 2 project contingency was not based on a sufficient understanding of the risks present. In this respect the Pasadena Line, MRL - Segment 3 - Eastside and future projects will benefit from the MTAs revised practice of concluding preliminary

engineering before adopting the budget. The Segment 2 contingency became more unrealistic after numerous owner-initiated changes affected the project at an advanced stage of design.

Based on discussions with various MTA staff and consultant managers, we believe the total contingency for MRL - Segment 2 is insufficient to cover likely expenditures. Three risk factors currently exist which, individually, threaten to consume the entire remaining contingency:

1. Insufficient allocated contingency to cover remaining construction contract escalations. Based on an analysis performed by Parsons-Dillingham, the Vermont and Hollywood boulevard construction contracts will require changes and related cost escalations similar to those of Wilshire corridor station, tunnel and systems contracts. Initial estimated growth exceeds *total* remaining project contingency
2. Pending and potential claims related to the B251 Vermont/Hollywood tunnel contract. Work stoppages have significantly impacted several systems and facilities contracts, likely yielding changes or claims. A host of community-initiated legal actions are also pending. The current assessment, though confidential, exceeds available contingency for the project
3. Transfer of full-burden costs of the Parsons-Dillingham construction management contract onto the MRL - Segment 2 budget. With the decision to replace Parsons-Dillingham as the CM for MRL - Segment 3 with another CM, many shared costs between Segment 2 and Segment 3 projects could be absorbed into the Segment 2 project. These costs include Parsons-Dillingham systems contract management, project controls, administrative and management overheads. Most of these costs are fixed costs which would be required to service CM responsibilities for either Segment 2 or combined Segments 2 and 3. Termination of the CM contract with Parsons-Dillingham may also generate added close-out and claims costs.

Concerted management actions will be required to mitigate these threats to the MRL - Segment 2 contingency. Specific cost-reduction efforts have already begun on the MTA Red Line project team to protect the allocated contingencies of Vermont and Hollywood contracts. These efforts include a thorough review of design-related changes to eliminate discretionary improvements. Potential claims resulting from the B251 contract will be much harder for the MTA to control. In the event that Parsons-Dillingham will maintain a significant involvement on Segment 3, the risk of additional CM contract expenditures consuming Segment 2 contingency will decrease.

5.3 Recommendations for Project Contingency

The MTA should Adopt a full risk assessment approach to determining project contingency. During budget development at the conclusion of preliminary engineering, the MTA and its consultants should identify all the risks associated with each element of the project. For each risk identified: (1) assign a probability of occurrence; and (2) quantify the likely cost impact of the occurrence. The total project contingency should be the sum of the individual contingencies required to address each risk identified. The MTA has accumulated a rich set of experiences from each of its past projects to assist it in identifying and quantifying risks. Many of the categories already in use to track construction contract changes in the Change Control System offer excellent starting points. A few examples include extra scope of work (e.g., work required of the contractor but not specified in the contract), differing site conditions (e.g., soil or environmental conditions not discussed in the contract) and designer-initiated changes.

For the most effective management, track project contingencies for each major risk identified. Throughout the project, the MTA project team should attribute cost increases to one of the risk factors identified during budget adoption. By drawing down the associated risk-related contingency, changes to the total remaining contingency are directly attributable to cause. Likewise, the MTA project team can judge more precisely the adequacy of reserves.

The above recommendations are predicated on the MTA's commitment to the Project Adoption process established during the Pasadena Line and MRL - Segment 3 projects. This will assure that project budgets and contingencies will be set only after preliminary engineering work are performed.

The MTA Red Line project team should provide a quantification of the full exposure the MTA faces on Segment 2 in a closed-door session of the Construction Committee <u>along with</u> MTA project team proposals for returning the project to more favorable budget status. In addition, the Red Line project team should issue, as soon as possible, all contract changes for remaining facilities and systems contracts on Segment 2, that, based on B221 and B231 analysis, will be absolutely essential on the Vermont/ Hollywood corridor. Based on prior discussions regarding the cost of a change versus its timing, the sooner these required changes are made in the construction process, the less expensive they should be.

The MTA should negotiate in good faith the impacts of added Parsons-Dillingham involvement on Segment 3. If the role of Parsons-Dillingham expands on Segment 3 to include the management of specific station and tunnel contracts, added cost transfers to the Segment 2 budget should be reduced.

With these recommendations, we believe the MTA will obtain the following benefits:

1. Better Planning of Future Rail Projects: Greater fact-based management through risk factor analysis will provide better information for future planning efforts. This will allow for accurately forecasted costs for a given capability
2. Superior Cost Control: Budgets based on current project realities offer valid mechanisms for controlling costs. Budgets frequently amended to track project changes offer little cost accountability. In addition, a more detailed accounting of contingency by risk factor will allow project management to effectively attribute cause and effect to cost escalations
3. Better MTA Board Involvement: Stable, reality-based budgeting as well as risk-factor contingency management offer a far more predictable management environment from which the MTA Board can operate. Confidence in the status of a rail construction project through enhanced budgeting and contingency management will allow the MTA Board to focus on longer-term policy issues and less on the merits of specific MTA staff or consultant decisions
4. Enhanced Ability to Attract Funding: A higher level of certainty in the final cost of a proposed project will greatly aide the MTA's ability to attract future funding by lowering investment risks
5. Reduced Costs of Changes: A quick identification and incorporation of the required changes for Vermont and Hollywood contracts will drive down the total cost. The sooner in a construction project a change is introduced, the less costly the change will generally be
6. Preservation of Contingency: Upfront determination of the likely cost impacts to be incurred will earmark a significant portion of allocated contingency and limit other changes from further eroding the reserve
7. Improved MTA Board Communications: By informing the MTA Board of the total cost exposure potential in addition to sharing recommended solutions, the full benefit of MTA Board management experience can be used more effectively
8. Greater Program Credibility: Funding sources will view more favorably an open and complete dialog on the current status of Segment 2 contingency. With realistic design plans, budgets and schedules, the MTA can manage the rail construction program effectively and establish a responsible image to the public

6.0 Project Alterations

6.1 Findings Regarding Project Alterations

Several owner-initiated changes to the design were introduced at various intervals during detailed design. Based on the observed cost overruns on Segment 1, the Segment 2 stations were originally designed with minimized interior spaces and fewer entrances. In November 1991, the LACTC requested that the RCC redesign two stations to improve their openness and appearance. These two stations were the B241 Vermont/Beverly and B252 Vermont/Santa Monica facilities. The concept became known as the "Great Space" redesign, which eliminated structural supports above the trainway and added a mezzanine bay at the foot of each escalator.

Both stations were well advanced in design, having completed the 85% pre-final phase. The redesign effort proved costly from the design perspective. However, with a "second look", designers were able to accommodate the enhancements while driving down EMC-estimated construction costs through value engineering. Exhibit 6 shows the total cost effect to Segment 2 for the "Great Space" enhancements.

	"Great Space" Costs (Savings)	
Facility	**Design**	**Construction**
B241	1,248	(3,939)
B252	1,420	(5,879)
Subtotal	$2,668	($9,818)
Total		**($7,150)**

Exhibit 6

Exhibit 6 shows that for this MTA-mandated enhancement, the net effect was a savings. However, "Great Space" negatively impacted the design budget.

Additional owner-requested station enhancements known as Option 1 and Option 2 followed in 1992. Several station designs were significantly affected, including B215 (Wilshire/Vermont), B241 (Vermont, Beverly), B252 (Vermont/Santa Monica), B261 (Vermont/Sunset), B271 (Hollywood/Western) and B281

(Hollywood/Vine). In the case of B271, the design had passed 100% completion and the section design team had disbanded when the redesign requirements were issued. Exhibit 7 shows the total costs to Segment 2 for these enhancements.

Exhibit 7.

	Option 1		Option 2		Total	
Facility	Design	Construction	Design	Construction	Design	Construction
B215			1,035	4,200	1,035	4,200
B241	970	3,500	562	639	1,532	4,139
B252	1,000	10,000	10	100	1,010	10,100
B261	570	4,000	468	11,030	1,038	15,030
B271			870	7,000	870	7,000
B281	960	6,500	340	3,500	1,300	10,000
Subtotal	$3,500	$24,000	$3,285	$26,469	6,785	50,469
add: Real Estate Costs		$6,000		$5,168		$11,168
add: Contingency		0		2,000		$2,000
Total		$33,500		$36,922		**$70,422**

Based on the estimates, the addition of Option 1 and Option 2 station enhancements resulted in a total cost increase to Segment 2 of over $70 million. These additions alone represent over half of the original Segment 2 project contingency of $130 million.

Responding to Joint Development requests, the MTA mandated yet another Segment 2 redesign to add a second entrance to B261 near the Kaiser Permanente hospital. Exhibit 8 shows the effect of this design change.

	Joint Development	
	Design	**Construction**
B261	$1,200	$5,995
Subtotal		$7,195
add: Real Estate Costs		$780
Total		**$7,975**

Exhibit 8.

Taken together, these mandated design changes resulted in an estimated $10.7 million in design cost increases and nearly $47 million in additional construction costs. Combined with an $11 million increase in Real Estate costs and a $2.8 million absorption of contingency, these three examples comprise $71 million in cost increases for Segment 2. Additional budget and funding allocations were made available for Segment 2 to address these changes. However, many MTA staff members and consultants believe they have been held accountable for the total project cost increase, including the $71 million discussed here.

6.2 Implications of Project Alterations

Section 2.0, **Issues of the Function** discussed several negative impacts of altering the project after designs and budgets have been established. The MTA has experienced the following for Segment 2:

1. Costly rework: Designs for several stations repeated the submittal process multiple times. The EMC and Section Designers were required to significantly alter drawings and specifications, all at considerable cost
2. Competitive Disadvantages: Many of the design changes may not have been totally refined prior to contract award. Consequently, design changes during construction were priced without the benefit of competition
3. Disruptive Control Environment: The EMC contract to provide design services for Segment 2 did not include provisions for the changes introduced. MTA managers responsible for design costs had a more difficult time monitoring progress without a suitable baseline.
4. Reputation for Change: The number and magnitude of Segment 2 project alterations may drive up future design services contracts
5. Demoralizing Effects: The MTA Segment 2 project team developed a "Tiger Team" initiative to drive down total project costs. Cost impacts of these MTA-mandated design changes consumed much of their efforts

6.3 Recommendation for Project Alterations

We recommend that the MTA strongly resist altering any rail construction project after the conclusion of preliminary engineering. The MTA can achieve this objective by implementing the recommendations contained in Section 4.0, Budget Adoption Process. While we recognize that complete

stability of the design is not always possible due to a variety of circumstances, the MTA Board and staff should take every effort to review the impacts of a proposed project alteration and delineate the expected costs as well as benefits. This will prevent misunderstandings and distrust from clouding management decisions.

7.0 Control of Design Costs

7.1 Findings Regarding Control of Design Costs

Design costs are estimated at the adoption of an overall project budget. These design costs include all EMC and subcontracted Section Designer costs for complete design services, design support during construction and any special studies the MTA requests or approves on behalf of municipalities and other third parties. The scope of design services for a specific rail construction project is defined by the Project Implementation Plan and by the more general program-wide EMC contract. Therefore, any additional work performed by a designer (the EMC or a Section Designer) deemed outside the scope of work defined by the Project Implementation Plan will, in most cases, generate additional costs beyond the original design budget.

For MRL - Segment 2, the budgeted AFE for design services has grown from $127 million (including the original MRTC contract for $49 million and the EMC contract value of $78 million) to a forecast of more than $154 million. This represents an increase of over $26 million for a 21% growth in the overall design budget. The MTA CCS system reports the increase using the following classifications:

Exhibit 9.

Red Line Segment 2 Design CCRs Caused By ...	Design Cost Increase
Other Agencies	$ 1,980,848
Design/Construction Contract Changes	13,854,647
Special Studies and Assignments	4,883,320
Unforeseen Staffing/Equipment Needs	5,704,410
Total:	**$ 26,423,225**

"Other Agencies" includes automatic sprinkler system designs, various municipality-driven changes, Americans with Disabilities Act mandates and other enhancements. "Design/Construction Contract Changes" primarily refer to changes initiated by the MTA Board and staff such as the "Great Space" and Option 1 design revisions.

A sizable portion of MRL - Segment 2 design cost increases have been attributed changes in owner preferences. Exhibit 10 depicts a subset of design cost growth attributable to selected MTA-initiated project changes.

Exhibit 10.

Red Line Segment 2 MTA-Initiated Project Change	Design Cost Increase
Transit Enhancements:	
Option 1 Station Enhancements	$ 3,500,000
Option 2 Station Enhancements	3,285,000
"Great Space" Redesign:	
B241 Vermont/Beverly Station	1,248,000
B252 Vermont/Santa Monica Station	1,420,000
Joint Development Enhancements:	
Kaiser-Permanente Entrance	1,200,000
Total:	**$ 10,653,000***

*MTA - Initiated Project Changes are also included in Exhibit 9 figures.

A significant portion of the design-related cost growth on Segment 2 occurred through increases in Section Designer hours. Engineering Change Requests (ECRs) are initiated by Section Designers for the

EMC to authorize additional design hours. An MTA Facilities Engineering Manager performed the following analysis of ECRs for two stations on Hollywood Boulevard shown in Exhibit 11:

Exhibit 11.

B271 (Hollywood/Western Station) ECRs 19 through 45	$	% of Total $	Engineering Manager Control?
Board Directed Enhancements/Mitigations	$779,083	23%	No
EIR, Agency and Codes	1,152,685	35%	No
Bulk Procurement Coordination	902,599	27%	No
Lessons Learned Program	75,008	2%	No
Elective Scope Modifications	91,272	3%	Yes
Elective Mitigations	235,190	7%	Yes
Value Engineering	88,047	3%	Yes
Total $:	$3.3 MM	100%	

B281 (Hollywood/Vine Station) ECRs 1 through 46	$	% of Total $	Engineering Manager Control?
Board Directed Enhancements/Mitigations	$1,432,514	45%	No
EIR, Agency and Codes	911,682	29%	No
Bulk Procurement Coordination	74,119	2%	No
Lessons Learned Program	174,110	6%	No
Additional Scope of Work	316,010	10%	Yes
Elective Scope Modifications	131,284	4%	Yes
Elective Mitigations	86,759	3%	Yes
Value Engineering	24,084	1%	Yes
Total $:	$3.2 MM	100%	

As indicated in the exhibits, "Board Directed Enhancements and Mitigations" are clearly beyond the MTA Engineering Manager's control. "EIR, Agency and Codes" consisted of changes mandated by the Americans with Disabilities Act, as well as changes to other local municipal safety and access codes. "Bulk Procurement Coordination" involved changes to mechanical rooms and other spaces due to the purchase of systems components sized differently than anticipated in the original facilities design specification. "Lessons Learned Program" refers to changes inserted into the designs of these station contracts after related changes were approved by the Change Control Board on stations already in the construction process. (Recall, however, that it is far cheaper to incorporate the changes in design, as is the case with these contracts, than to affect the change during construction). Each of these ECR classifications are outside the primary control of the Engineering Manager. Reasons for "Additional

Engineering Scope" changes included additional analyses or design clarifications. "Elective Scope Changes" were driven by MTA management for improving aesthetics ("Great Space" studies), responses from contract bidders and other selected improvements. "Elective Mitigations" for both stations primarily involved station shaft relocations to be nearer street curbs. "Value Engineering" changes consisted of changes to emergency stairways, gratings and walkways. These ECR classifications are generally within the MTA Engineering Manager's control.

The MRL - Segment 3 - North Hollywood project team, benefiting from the experiences of Segment 2, has enacted many policies to address ECR-related design cost growth. A more formal Budget Adoption Process mandates that preliminary engineering and all environmental impact work be concluded before finalizing a contract for design services (*refer to* Sections 4.0, Budget Adoption Process and Section 5.0, Project Contingency). With greater up-front involvement from safety, operations and other disciplines, the likelihood of required design changes after commencing design is reduced. Bulk procurement and Lessons Learned design changes are less probable with increased standardization (*e.g., modular stations*) and continued program maturity.

The Segment 3 team also took steps to establish advanced budgeting for items not originally planned in Segment 2. Budgets for Segment 3 specifically identify amounts for special studies, the ART program, Joint Development changes and other items for improved management and Board visibility.

For Segment 2, a sizable portion of design service cost growth is attributable to these examples of MTA-directed enhancements. However, when viewed programwide, the cost growth is primarily represented by "Unforeseen Staffing/Equipment Needs". Collectively for all projects and special studies, the design-related cost increases associated with the EMC are provided in Exhibit 12:

Exhibit 12.

Programwide Designer CCRs Caused By ...	Design Cost Increase
Other Agencies	$ 5,347,135
Design/Construction Contract Changes	19,566,384
Claims and Disruptions	35,771
Special Studies and Assignments	4,883,320
Unforeseen Staffing/Equipment Needs	125,322,633
Total:	**$ 155,155,243***

* Refers to Programarde design cost increases. Exhibits 9 and 10 refer to MRL - Segment 2 design cost increases only.

The contract to perform design services for MRL - Segment 2 was originally established with the Metro Rail Transportation Consultant (MRTC), the precursor organization to the EMC. This design contract was executed by the LACTC Planning and Programming organization, and predates the involvement of the RCC in the project. The RCC engineering and cost estimating functions did not provide input during Conceptual Design or during the establishment of the design services contract with the MRTC. In addition, the overall project budget of $1.446 billion had already been established, as well as the total design budget authorization of $86 million. It should be noted that the original engineering budget of $86 million represents less than 6% of the total original project budget.

Early into the preliminary engineering phase, the Engineering Management Consultant (EMC) joint venture was formed to replace the MRTC. MRTC had already expended $51 million for design when the EMC issued a Project Implementation Plan proposal to complete the design of Red Line Segment 2 for an additional $111 million. The RCC eventually negotiated the amount to $78 million.

The Project Implementation Plan (PIP) for design services on MRL - Segment 2 did not fully detail the baseline design effort to be performed. For example, the PIP did not adequately specify the number of drawings per major work package, the design hours associated with each drawing or design budgets for section designers.

7.2 Implications of Control of Design Costs

For MRL - Segment 2, nearly $11 million, or 42%, of the overall growth in design cost of $26 million is directly attributable to MTA Board-approved changes to the project, including the "Great Space", Option 1 and Option 2 station enhancements, as well as community betterments such as street widening or addition of sidewalks. Much of the growth in design consultant fees, with respect to Segment 2, are the result of conscious decisions by the MTA to alter the project after project/budget adoption has occurred.

The original budget of $86 million for design services for Segment 2 significantly underestimated the true design effort that would be required. This is a result of a budget adoption process that did not incorporate preliminary engineering knowledge.

The EMC contract to provide design services for MRL - Segment 2 lacks the appropriate mechanisms to effectively control design costs. MTA project engineering managers do not have an adequate baseline to judge design progress between design review milestones. Such a baseline would define the hours budgeted for a specific design task, perhaps by the number of hours per drawing, the number of drawings for each work package and other requirements prior to each submittal. Without this baseline, engineering and project control managers cannot apply the Earned Value tool to maximum effectiveness, increasing the likelihood of design hour overruns. While the MTA may award fees to the EMC for the hours overrun, the MTA is still required to cover costs.

The Project Implementation Plan and Contract Work Order for design services for MRL - Segment 3 - Eastside, by contrast, should enable the MTA to more effectively managing design costs. It contains much of the required baseline detail to monitor EMC and section designer progress. In addition, design support during construction has been budgeted in advance using historical volumes of requests for information and response turnaround effort.

Even with a sound design contract which specifies in great detail the work to be performed, unforeseen circumstances occur which necessitate a change to the designer's scope. These circumstances include changes to municipal codes or outside agency interpretation of codes (fire, security, access, etc.) as well as changes in owner preferences during design. The MTA is in a position to reduce the number of owner changes but must assign an appropriate contingency to design growth based on the other factors listed. The Segment 3 budget includes specific amounts for many items such as special studies, the ART

Program and Joint Development alterations. By raising the visibility of individual contributors to design cost escalation, the overall design budget can be managed more effectively. In addition, the whole issue of design cost escalation becomes less contentious and accusatory when the MTA Board and parties understand the nature and cause of each cost increase.

For programwide design cost increases, $125 million of the total $155 million increase, or 81%, is classified as "Unforeseen Staffing/Equipment Needs". We believe that the magnitude and classification of this amount characterizes a lack of sufficient control over design costs. Causes for the lack of control include the issues of premature budget adoption, changing MTA design directions and weak contracts discussed above. **Please refer to Chapter VI, Volume B - Contract Administration and Chapter IX, Volume B - Change Orders and Claims for additional information.**

7.3 Recommendations for Control of Design Costs

We recommend the MTA negotiate the final detailed design contract during total project budget formation in order to best reflect the required design budget elements. The MTA can implement this recommendation only if preliminary engineering activities have sufficiently concluded prior to budget adoption.

Perform a review of EMC contract changes to determine any or all applicable changes that may be incorporated within the original scope of work for future preliminary engineering or detailed design services. Using the latest Project Implementation Plan negotiations experience for MRL - Segment 3 - Eastside, further refine requirements including the definition of specific design work elements, the number of drawings per element, the number of hours per discipline per drawing and any other quantifications of baseline scope.

Assign specific project contingencies to potential changes in designer contracts. Utilize the analysis of ECR classifications performed for contracts B271 and B281 outlined above as a guide for risk factor analysis (refer to Section 5.0, Project Contingency).

With these recommendations, we believe the MTA will obtain the following benefits:

1. Reduction in Design Cost Increases: Contracts with a more detailed baseline requirement provide many additional mechanisms for the MTA to control designer cost escalation
2. Better Owner-Designer Working Relationship: Better-defined contracts not only serve the owner's desire for control, but allow the design consultant to better manage efforts and avoid repeated requests for contract changes
3. Improved Contingency Management: Assigning specific contingencies to design cost growth and establishing specific budget allotments for discretionary studies provides a tracking mechanism linking overall project cost growth to specific design requirements

8.0 Control of Construction Costs

8.1 Findings Regarding Control of Construction Costs

Findings Regarding Managing to the Authorization For Expenditure

Each construction and procure/install contract the MTA awards receives an allocated contingency - typically 10% of the contract award value. Taken together, the contract award value plus allocated contingency comprise the Authorization For Expenditure (AFE). Stated another way, the allocated contingency is the difference between the MTA Board Authorization for Expenditure and contract award amount. Refer to Exhibit 13.

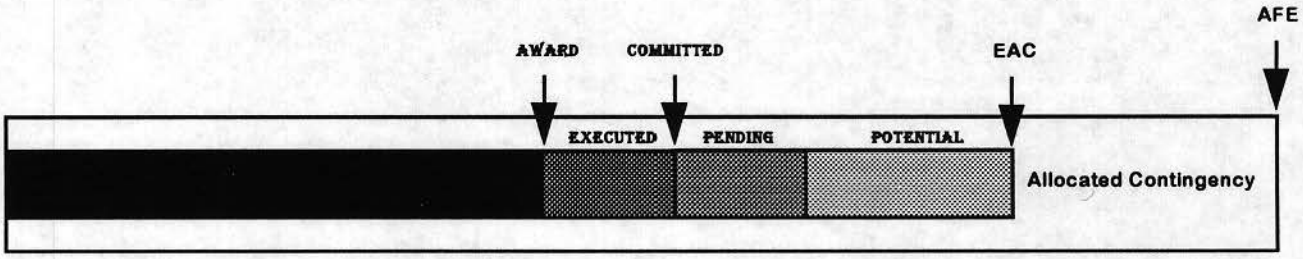


Exhibit 13. Authorization for Expenditure

The contract Estimate At Completion (EAC) is made up of the initial contract award, executed changes which together make up the current commitment, pending changes and potential changes and claims. During the life of the contract, the EAC grows as changes are executed and potential changes are

foreseen. Exhibits 14 depicts the growth in EAC relative to the AFE window, while Exhibit 15 illustrates an EAC calculation for the Wilshire/Western station.

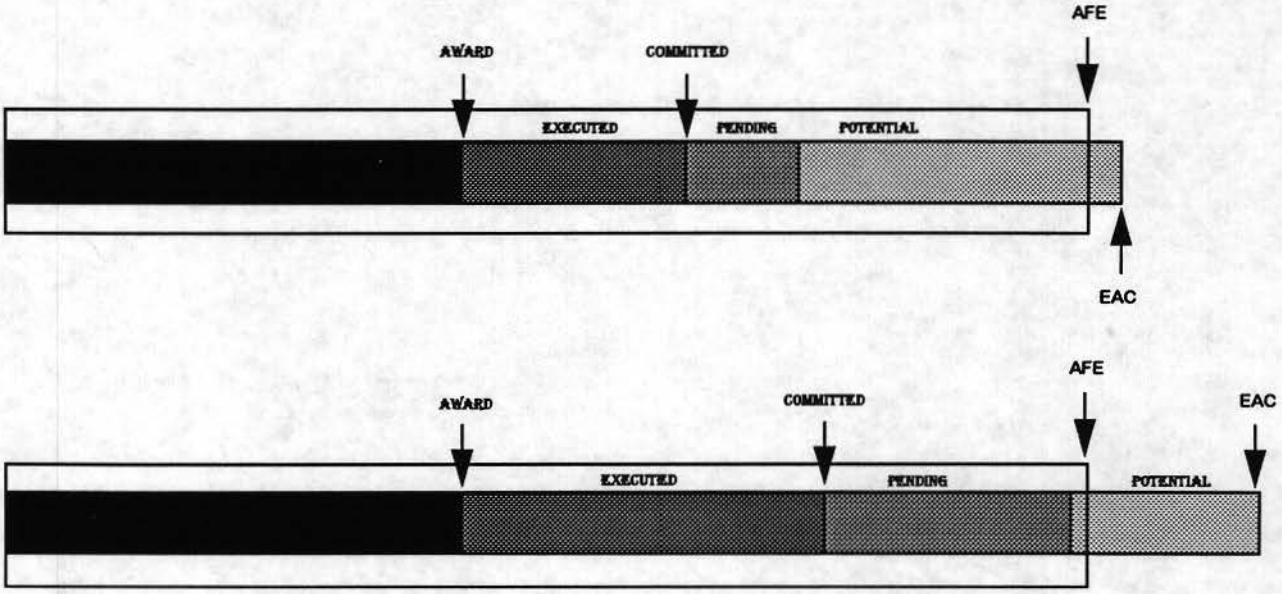


Exhibit 14. Growth in EAC

Eventually the EAC may exceed the AFE window. When the pending commitments, which are changes in-process, approach the AFE limit (bottom bar), the Board is forced to make rapid approval of an AFE increase to allow cash payment to the contractor.

For MRL - Segment 2, the AFE has been extended on contracts B201 (MacArthur Lake pocket track and tunnel), B211 (Wilshire/Vermont stage-1 station contract) and B221 (Wilshire/Normandie station and tunnel).

Based on our discussions with several resident engineers, a general perception exists that the AFE constitutes the contract "budget". Some Resident Engineers feel that the allocated contingency represents their management contingency and that the MTA (including the MTA Board) should not concern themselves unduly with a given construction contract unless the EAC appears likely to exceed the AFE.

Findings Regarding Tracking of Potential Changes

For each construction and procure/install contract, the contractor is required to submit a Potential Change Order (PCO) log to the CM Resident Engineering office each month. The PCO log lists all of the potential changes the contractor sees on the horizon, as well as his estimated cost to the owner. The CM and the MTA also maintain an independent log within the Change Control System (CCS) of potential changes. The CM Project Control Engineer (PCE) assigned to each contract under CM management is responsible for reconciling the contractor's PCO log with the information already maintained in CCS. Updated potential change information from the CCS system is the basis for the CM's forecast contract cost at completion, also known as the Estimate At Completion (EAC). Exhibit 15 illustrates this calculation for the B231 Wilshire/Western Station.

DESCRIPTION	STATION CURRENT VALUE 12/30/94
Award Value	$53,645,201
Executed Changes	$4,707,082
Work Authorization Change Notices:	$522,090
Approved Change Orders	$5,229,172
CURRENT OBLIGATED VALUE	$58,874,373
Pending Changes	$365,682
TOTAL LOGGED VALUE	$59,240,055
Pending Claims	$540,826
Potential Changes	$62,628
Potential Claims Under Review	$867,332
PENDING CLAIMS, POTENTIAL CHANGES/CLAIMS	$1,470,786
Forecast	$60,710,840
Allocated Contingency	$39,160
ESTIMATE AT COMPLETE	**$60,750,000**

Exhibit 15. EAC Calculation for B231 Wilshire/Western Station

On occasion, a PCE has failed to incorporate all of the contractor's PCO entries into the CCS potential change database. In other instances, a PCE has excluded PCO entries with $0 values from the potential change database, or has not attributed a rough estimated cost in place of the $0 entry.

Another impact on the quantification of potential contract changes is the differential between a contractor's estimated cost and that of the Resident Engineer. For example, a contractor may carry a potential change in the PCO log with his estimate of $100,000. The Resident Engineer, however, may judge the change to be of no merit or, perhaps, no more than $10,000 in value. Often, the Resident Engineer's value is the quantity entered in the CCS potential change database.

The current process for reconciling the PCO log, the CCS potential change database and other information from the Cost Management System (CMS) is very time consuming. As currently configured, the CCS and CMS systems are not integrated to facilitate the exchange of data. PCEs must prepare separate spreadsheets for calculating costs, commitments and expenditures at the Work Package, Fund and MAC code level before updating the CMS system and generating management reports.

8.2 Implications of Control of Construction Costs

Implications of Managing to the Authorization For Expenditure

Cost control concerns naturally arise whenever the EAC exceeds the AFE window. At the point when commitment levels approach the AFE window cost control concerns become **cash flow** concerns. The MTA committed payments to the contractor for which an authorization has not been approved. Due to the length of time required by the MTA Board to approve a change to the AFE and the cash flow issue involved, the MTA Board was not afforded ample time to review AFE increases. By delaying significant discussions with the MTA Board regarding the likely allocated contingency inadequacies, MTA staff limited the Board's role to administrative approval as opposed to management input.

By viewing the AFE limit as the contract budget, Resident Engineers may be less willing or feel less of a need to fully share the current status of a contract until commitments approach the AFE. This may virtually guarantee that the AFE will be used up on a contract.

Implications of Tracking of Potential Changes

Omitting contractor-identified changes from the CCS potential change database or carrying potential changes at $0 value understates the MTA's exposure to potential contract changes. Without incorporating all known risks to the contract, forecasts of cost at completion lose a measure of value.

The proper role of the Resident Engineer includes determining the merit and value of potential contract changes. However, a sizable spread between the contractor's estimated cost of a change and the resident engineer's determination represents a quantifiable risk to the contract's cost growth. In the example listed above, the spread between the contractor's $100,000 estimate and the Resident Engineer's $10,000 estimate is $90,000. The probability that the change will be negotiated somewhere within this $90,000 window (that is, above $10,000) is greater than zero. Therefore, the potential change total for the contract will be understated. Collectively for all such change discrepancies on this and every construction contract, the total MTA cost exposure forecast on a monthly basis is understated.

8.3 Recommendations for Control of Construction Costs

Recommendations for Managing to the Authorization For Expenditure

Establish a regular status report to the MTA Construction Committee of all contracts with commitments likely to exceed the AFE window. Utilize closed sessions of the Committee whenever sensitive issues, such as possible claims settlements, preclude public access. For this to work, the MTA Board must strive for open communication between itself and MTA staff. Above all, the Board must create an environment that will allow the free flow of information about problem contracts. This can only be achieved when the aim of Board inquiry is problem resolution rather than fault finding.

With these recommendations, we believe the MTA will obtain the following benefits:

1. Reliable Estimates at Completion: An earlier, more complete sharing of information between the Resident Engineer, his PCE, MTA staff and ultimately the MTA Board will add credibility to forecast cost figures
2. Better-informed MTA Board : Open communication mechanisms that value honesty will encourage MTA staff and consultants to share the complete picture of current rail construction issues

3. Superior Cost Management: Open dialogs between the MTA Board, MTA staff and consultants enables the experience each groups possesses to be directed toward problem solving to mitigate cost escalations

Recommendations for the Tracking of Potential Changes

In order to provide the MTA a more robust contract EAC figure, all knowledge of potential changes must be incorporated. **Establish a program-wide set of potential change tracking procedures that will apply to each MTA project control team. See Section 3.3, Recommendations for Organizational Roles and Responsibilities for revisions to the team project control structure.** These procedures should include the following:

1. Contractor requirements for submitting PCO log information electronically each month
2. Methods required for PCEs to reconcile CCS and contractor PCO information
3. Requirements and methodologies for PCEs to supply an independent assessment of potential change values whenever the contractor and Resident Engineer differ greatly in their assessment. Quantitative probability methods are preferable

The MTA should expedite efforts to integrate the CCS and CMS systems. The vast majority of duplicate data entry and the use of supplemental spreadsheets should be eliminated with a proper data exchange mechanism. Software diagnostic tools can be created to reliably scan contractor PCO logs and compare the information with the CCS potential change database and highlight exceptions.

Clearly state the accountability that both the Resident Engineer and the project controls team share in the validity of forecasts. Place the integrity of the forecast at the same priority level as the magnitude of contract growth. A portion of individual project control team member evaluations should include a measure for the validity and completeness of forecasts.

With these recommendations, we believe the MTA will obtain the following benefits:

1. Reliable Estimates at Completion: A more complete incorporation of potential change information will reduce the MTA's unknown cost exposure and provide an earlier warning of problems
2. Better Cost Trend Analysis: Improved information systems will free PCEs of time-consuming data entry to perform value-added "what if" and cost trend analyses

3. System of Checks and Balances: Independent assessment by the PCE of potential change values provides a second opinion to that of the Resident Engineer on contract status
4. Superior Cost Control: Taken together, reliable, timely and more independent cost information will allow the MTA and its consultants to make better management decisions to control costs.

XII. Project Control - Reporting and Management Reporting

CHAPTER XII
Volume B

PROJECT CONTROL - REPORTING (AND MANAGEMENT REPORTING)

1.0 Nature of the Function

The general objective of Project Control - Reporting is to provide timely and accurate information necessary to monitor and control project performance. Information must be provided in sufficient detail to allow recognition of current and potential problems enabling management, staff and consultants to take the appropriate corrective actions. Specific benefits obtained include the early identification of actual or forecasted variances allowing rapid and effective management response. Further, the availability of accurate historical information improves management's ability to plan for future projects.

The aim of the Project Control- Reporting function is to provide the MTA, the public, the Funding Agencies (i.e. FTA), and the consultants with accurate cost and schedule information. Accurate information allows all interested parties (especially the MTA, EMC and CMs) the ability to monitor project budgets, commitments and forecasts. The initial sections of this chapter address Management Reporting (also called Progress Reporting) while the latter portions discuss Project Control-Reporting.

The Project Control - Reporting function includes the process of preparing management reports. Management reports are structured differently than project report. Management reports include only the information required to meet the needs of the specific level of management. Program Control reporting generally includes information that is more expansive than management reporting, because project reporting is used to monitor and control the project during design, construction and start-up.

Information should be tailored to meet the needs and objectives of its users. Reports used by top management will differ significantly from reports used by those responsible for day to day construction activities and decision making. Accordingly, management reports should follow a hierarchical format with concise, exception oriented reports at the top and detailed, data-filled reports at the bottom. (Please see Exhibit 1 for an illustration of this structure.)

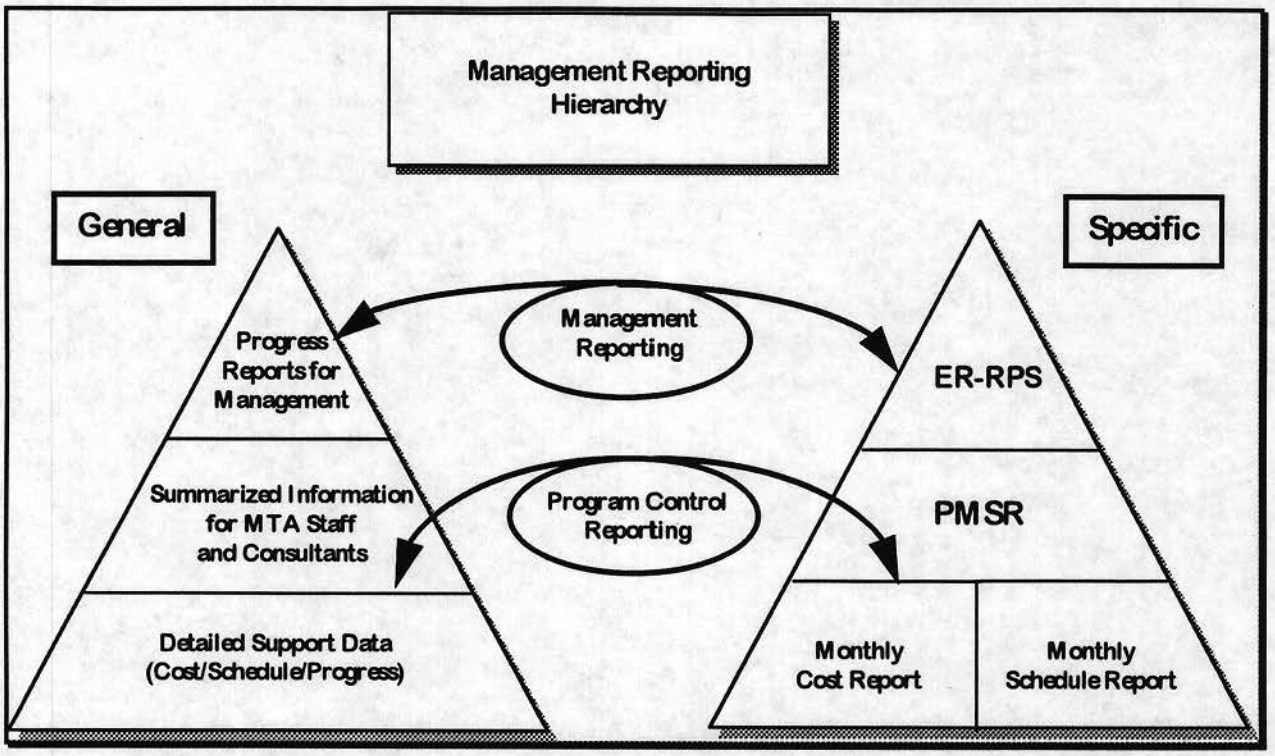


Exhibit 1

Management Reporting plays a critical role in enabling the MTA to effectively meet its project oversight responsibilities. While a knowledge and understanding of project history are essential to these efforts, in and of themselves, they are not sufficient. To be effective, Management Reporting must also facilitate the processes of project planning, monitoring and analysis.

Reporting that naturally highlights risk areas as well as unfavorable variances and trends will greatly enhance the value of the reported information. Exception-oriented reporting provides greater visibility of potential risks and problems. When too much information is presented, important areas lack this visibility and potential problems can go unnoticed.

Additionally, data analysis is critical for effective Management Reporting. By transforming the role of the report from merely providing project history to providing useful information and insight to facilitate problem identification and their root causes will greatly enhance the reports. High quality reports facilitate early identification of problems and viable alternatives. The problems identified may have cost, schedule or technical impacts which require special resources to resolve. Enabling the early

identification of problems and their causes, as well as the needed resources and actions to resolve them, is an essential element of effective Management Reporting.

Once potential problems have been identified, an action plan should be developed by the CMs, EMC and the MTA Staff that proposes solutions and assigns action steps and timing requirements to specific individuals. Proper Management Reporting requires the documentation of these necessary actions and it should provide a mechanism for monitoring the performance of the action steps and their effectiveness.

2.0 Issues of the Function

Currently, the Management Reporting function is organized to meet the MTA's objectives that:

- MTA Board Members and Executive Management are fully informed of the project status
- Timely and accurate data is available to MTA management enabling it to anticipate and respond to actual and potential problems
- Historical data is maintained to be utilized in planning for future projects
- Reports comply with funding agency's (i.e. FTA) reporting requirements

2.1 Overview of Reports Created

The MTA utilizes several standard monthly reports to achieve its management reporting objectives. Following are five commonly used monthly reports:

1. Executive Report Rail Program Status
2. Project Manager's Status Report
3. Monthly Project Schedule Report
4. Monthly Project Cost Report
5. Monthly CM Cost/Schedule Report

As stated previously, to be effective, these reports must be tailored to the needs of their users. Accordingly, reports used by individuals responsible for day to day operations will differ significantly from those used by top management. This requires that reports be organized along a hierarchy with concise overview reports presented at the top and detail oriented reports at the bottom. In addition to top-to-bottom reporting, information should be organized along functional lines (e.g. design,

construction, systems, etc.) to facilitate responsibilities to be identified and addressed within the reports. Exhibit 1 reflects the hierarchy that exists within the reports prepared by the MTA.

Reports presented to the MTA Board are at the top of this hierarchy. These reports need to provide an overview of construction progress with an emphasis on issues requiring the Board's attention. In general, these reports should describe broad cost and schedule results/progress, provide a discussion and analysis of significant variances and list areas of concern and proposed actions. A responsible party should be identified to address each concern, with an assigned due date, to allow the Board to monitor the effectiveness of proposed actions. Finally, these reports must be presented in a timely manner to allow effective decision making on the part of the Board, and effective actions on the part of the MTA Staff and consultants assigned to address the issues.

For the MTA, data is maintained primarily on the Cost Management System (CMS) and the Change Control System (CCS). This data is combined with cost and schedule forecasts, variance analyses and other relevant information to form specific reports. Project status data is linked to financial performance measures in order to facilitate resource and cash-flow planning. Additionally, data must be analyzed, edited, reconfigured, the layout determined and the finished products produced and distributed to complete the Program Reporting process.

The following identifies further details about each of the five primary reports of the MTA:

2.2 *Executive Report Rail Program Status (ER-RPS):*

This progress report is primarily used to keep MTA Board members apprised of the construction activity (progress) and the general schedule and cost status of each program. This report contains approximately 10 to 20 pages of program-wide information on budget, schedule, cash flow, funding sources, safety issues and staffing levels. Stand alone information covering the same topics is also presented for each project (MRL - Segment 1, MRL - Segment 2, etc.), and vehicle procurement operations. Each section is approximately 15-25 pages in length and is extracted from each of the Project Manager's Status Reports.

A great deal of useful and important information is included in this report. For example, the report highlights areas of concerns and proposed actions, key activities planned and accomplished and

updated forecasts. However, because of the reports overall length (nearly 100 pages) this information is not sufficiently visible. Providing information in such exhaustive detail can hide important variances.

The majority of the report represents a historical recitation of project cost and schedule activities. Most graphs and charts are presented without an accompanying analysis or an explanation of their relevance, diminishing the reports value as a management tool. Additionally, much of the information provided represents cumulative totals making comparisons of periods and trends difficult.

2.3 *Project Manager's Status Report (PMSR):*

This report is produced monthly for each Metro project (e.g. MRL - Segment 2) by the responsible CM. The report's primary user is the PM, however, Real Estate, Planning and PMOC personnel also review this report. The PMSR includes an Executive Summary of approximately 20-30 pages which highlights budget, schedule, cash flow, funding, safety issues and staffing levels. Supporting the Executive Summary are separate sections containing detailed cost, schedule, real estate and construction/procurement data. In total, these sections are 90 to 100 pages in length.

Several important aspects of project control are highlighted in the PMSR. In particular, areas of concern and proposed actions are presented. Updated forecast and budget information is provided, as well as a listing of key activities planned and accomplished during the period. However, critical information within the PMSR is not sufficiently visible due to the overall length of the report. The valuable exception reporting data is not summarized and presented in the front of the report. Additionally, much like the ER-RPS, many items are presented as cumulative totals making comparisons of periods and identification of trends difficult.

Targeted date for delivery of the PMSR is ten days after month end. Typically, the report is delivered twenty calendar days after month end. Given the volume of construction activity, data provided twenty days after month end has the potential to become outdated or irrelevant before the report is actually delivered. The delay in production is often due to the time it takes to acquire all the data necessary for the report.

The Project Manager is a senior position within the MTA. Therefore, status reports provided to this position should be fairly concise and exception oriented. Reports highlighting exceptions increase the visibility of potential and existing problems thereby focusing attention on their resolution. Additionally,

visibility of potential and existing problems thereby focusing attention on their resolution. Additionally, providing data in a timely manner allows rapid response, minimising negative impacts.

2.4 *Project Cost Report:*

The Project Cost Report is used by the Project Control - Cost Manager and other cost management personnel. This report is produced monthly and contains comparisons of budgeted to actual cost information, project cost by element (construction, real estate, professional services) as well as cash flow and commitment information, trend reports, budget and contract changes. The report is approximately 60- 70 pages in length. Several graphs and tables are imported from this report into the PMSR.

As this report is used by the Project Control - Cost Manager and other cost control personnel, the information should be and is presented at a much more detailed level than that contained in the PMSR. However, this report, like the ER - RPS and the PMSR, does not sufficiently highlight variances and potential problems. For example, the report contains over 30 pages of cost detail by element, line item and work package classification. Original budget, commitments, costs incurred, expenditures, current forecast and forecasted variances are presented for each of over two-hundred such line items. Those line items with significant variances are not highlighted or brought to the reader's attention. Additionally, no explanation or analysis accompanies the schedules. Finally, the schedules do not provide or realistically allow any comparison with previous periods of what actions, if any, have been accomplished.

2.5 *Project Schedule Report (PSR):*

The Project Schedule Report is prepared monthly and is used by the Project Control- Schedule Manager and other Project Control Personnel. The report is comprised of an Executive Summary which describes critical path issues, schedule recovery plans for those tasks with significant negative float and a summary of schedule changes.

The Executive Summary is supported by a number of sections. Many sections cover the same topics but present information at successively lower levels of detail. This is an especially useful feature because it allows a reader to probe and analyze issues identified from the summary data, at a sufficiently low level of detail, if they need a further understanding of the schedule issues.

2.6 *CM's Project Cost/Schedule Report:*

This report is prepared on a monthly basis by the CM of MRL - Segment 2 and is used by PMs, Deputy Project Managers, CA personnel and MTA Project Control personnel. It is approximately 35 to 40 pages in length and contains a cost outline, estimate at completion information, contingency status, schedule outlines, highlighted areas of concern and cost forecast calculation summaries for all contracts anticipated to exceed their AFE. An appendix is attached listing project milestones, reconciling forecast changes and more detailed cost information for those contracts experiencing cost or budget constraints.

This report allows easy comparison of budget to actual performance to date and for the period presented. "Estimate at Completion" information is provided in a format which allows easy identification of cost growth and variances. The level of detail presented, and the overall length of this report, are appropriate given the needs of its users. However, there is insufficient detail within this report to identify the remainder of allocated contingency on a per contract basis.

3.0 Findings and Implications of the Function

As described above, there are several reports produced by the MTA and its consultants during any given month. In its current format, the Executive Report - Rail Program Status does not meet the management reporting needs of the Board. As noted, the report contains useful and important information but it does not sufficiently focus the Board's attention on areas of concern. Reports provided to the Board need to be exception-oriented in order to highlight significant problems and allow evaluation of their proposed solutions, without the reader having to wallow through large volumes of base data. Individuals responsible for follow-up action need to be identified to allow adequate monitoring. Finally, due to the volume of construction activity, the current monthly frequency does not provide sufficient notice for top management to proactively respond to those issues requiring its attention.

The volume of data available within these reports is excessive, but the volume of information available for the Board and top management is limited because of the presentation of the data and the lack of data analysis, interpretation and summarization. The volume of cost information is so extensive, the valuable information is masked, not presented or improperly characterized.

3.1 *Example of Inconsistent Information Presented in MTA's Reports that is only Visible After Detailed Review*

The Executive Report on Rail Program Status (ER-RPS) is the primary report for the Board and top management. They should be provided accurate and timely information, summarized for ease of review and understanding. The following example describes (a) an inconsistency with the perception of the MRL - Segment 2's cost growth and (b) the difficult process that a Board member would need follow to glean additional, more relevant information from the volumes of data that currently exist within the MTA. The current MTA report does not show the true and full cost picture for each project. For example, in the Board Report for MRL - Segment 2 the reader is presented with a graphic that shows the cost growth trend for construction and systems contracts over the last eight months, currently stated to be 5.2 percent. This growth percentage is classified as "obligated and pending" cost growth. This trended graphic could be interpreted by the Board to be the cost growth anticipated for the project, because no additional cost growth information is summarized within the progress report presented. However, when one analyses the full compliment of cost data available, the true forecasted cost growth percentage of construction and systems contracts is 16 to 17 percent. A Board member reviewing their progress reports would not receive that important piece of information.

Step 1: The Executive Report on Rail Program Status (ER-RPS) for December reports on Page i of the MRL - Segment 2 section that for MRL - Segment 2 Construction and System contracts that the obligated and pending cost growth is 5.2%. This is a positive/favorable indicator for the Program, because the program budget is based on a 10% anticipated cost growth (contingency).

Step 2: The 5.2 percent cost growth is then detailed on page 16 and 17 of the ER-RPS (MRL - 2 section) by contract. The figure is in the lower right hand corner of the report.

Probing into the actual details of the MRL - Segment 2 contracts, and the total forecasted cost growth for these contracts, reveals a significantly different story.

Step 3: The ER-RPS does not provide any additional forecast details on the Project, so you have to then turn to the PMSR for additional information. Turning to Page CS-14 in the PMSR (over 40 pages into the report) the unallocated Contingency Status is reflected. This is a line graph

reflecting the volume of the unallocated contingency over the life of the project. The graph shows that the unallocated contingency has declined to approximately 10% of its original level, even though the project is only 50% complete. This graph is a strong warning indicator of a project that is suffering cost growing pains.

Step 4: The second indicator of concern regarding the sufficiency of the project's budget is reflected in summary details on the PMSR at page CS-7. The forecast total for the Construction coded elements reflects over $1 Billion in forecasted costs for contracts that have an original budget of $893 million. **This is a projected 12.5% cost growth over budget.** Because this page (CS-7) only summarizes the details into 10 lines, it becomes necessary to move deeper into the reports to identify the potential cost growth for just the construction and systems contracts.

Step 5: It is necessary to combine the detailed cost report from the PMSR (titled "Project Cost Report - Cost by Element/Line Item/ Work Package) located at the end of the PMSR, with the Project Change Activity Summary included in the PMSR on Page 16 and 17 to address the cost growth details for construction and system contracts. When you combine the two reports ("award amounts" from PMSR Page 16 and 17 and "forecast data" from the last cost report in the PMSR), you can assess the construction and system contract's cost growth. The analysis is reflected in Exhibit 2, as follows:

Forecasted Contract Costs (in 000's)
Red Line Segment 2
Source: PMSR for December 1994

Contract	Award Value	Current Percentage Complete	Executed Change Orders	Approved WACN	Pending Changes	Potential Changes, Claims & Remaining Contingency	Adjusted Forecast	Cost Growth (Percent of Award)
B215	$26,178	38%	$40	$816	$131	$2,880	$ 30,045	15%
B221	79,813	91%	5,714	3,055	2,605	6,081	97,268	22%
B229	957	63%	45	9	25	32	1,068	12%
B241	40,957	22%	50	253	546	4,005	45,811	12%
B251	129,655	77%	554	4,009	2,891	27,199	164,308	27%
B252	50,879	12%	103	0	1,017	4,731	56,730	11%
B261	44,967	13%	(50)	247	90	4,147	49,401	10%
B271	38,948	6%	(110)	60	3,612	1,833	44,343	14%
B281	49,287	10%	2	467	281	5,164	55,201	12%
B610	16,690	28%	17	147	(1,152)	2,657	18,359	10%
B611	2,719	34%	0	0	(177)	449	2,991	10%
B612	3,994	26%	0	0	0	149	4,143	4%
B614	2,647	41%	1	0	0	0	2,648	0%
B616	759	0%	0	0	19	58	836	10%
B620	18,031	48%	(179)	145	(108)	1,445	19,334	7%
B630	6,157	18%	103	0	0	494	6,754	10%
B631	4,467	14%	0	0	396	51	4,914	10%
B641	10,230	0%	0	0	(2)	1,025	11,253	10%
B642	1,102	0%	0	0	0	110	1,212	10%
B643	780	0%	0	0	0	78	858	10%
B644	3,261	0%	(6)	0	(896)	337	2,696	-17%
B645	2,566	0%	0	0	(126)	383	2,823	10%
B646	2,548	0%	0	25	147	283	3,003	18%
B648A	2,206	0%	0	0	(126)	347	2,427	10%
B710	14,443	5%	10	0	826	1,879	17,158	19%
B740	10,526	39%	251	0	(157)	511	11,131	6%
B745	1,808	40%	405	0		124	2,337	29%
B760	484	0%	0	0	(30)	79	533	10%
B761	3,227	30%	74	0	59	189	3,549	10%
B795	2,004	15%	0	0	0	201	2,205	10%
Subtotal	$572,290		$7,024	$9,233	$9,871	$66,921	$665,339	16%
Additional Contracts	$194,532						$225,390	16%
Total	$766,822						$ 890,729	16%

Exhibit 2

The Award values come from Page 16 and 17 of the PMSR and the Current Forecast comes from the Detailed cost report located at the end of the PMSR. From the tabulation shown above, the cost growth forecast for construction and system contracts included in the ER-RPS's calculation of the 5.2%

figure, is **16%**. A Board member reviewing the ER-RPS would not receive this message by reviewing the Management Report.

The ER-RPS provided to the Board indicated that the cost growth is only 5.2% for obligated and pending changes. Technically that percentage appears to be correct, but that percentage does not tell the Management and the Board the whole story. The detrimental information is reported in pieces that are not easily discernible or they are so buried in the detailed data that it would be unreasonable for a Board member to identify and quantify the data to convert it to valuable management information. Once the pieces are accumulated, it is possible to see that for many of the construction and system contracts, they are forecast to exceed their budgets (greater than a 10% cost growth). If this volume of contracts ($767 million) is forecast to grow by 16%, the overall budget and remaining contingency are suspect, considering the program is only 50% complete.

The previous discussion is one example of the MTA reports providing a great deal of data but very little valuable management information for decision making. The above situation should be presented to the Board through the narrative section of the ER-RPS or an oral presentation. As described, the above information is not presented in the ER-RPS - it must be calculated. The data is somewhat covered in Project Cost/Schedule Report prepared by the CM of MRL - Segment 2 on a monthly basis, but it to needs to be analyzed to obtain a valuable message (in a Management useable form).

3.2 *Another Example of Cost Growth Information Extracted from MTA's Reports*

<u>The current Management report does not provide ample summarized information to assess the risk differences that exist within contracts</u>. If the monthly detailed cost data is analyzed, it is possible to determine the forecasted cost growth for the different types of contracts. This forecast cost growth would then be evaluated against the 10 percent contingency established for the contracts to determine if the contracts were forecast to exceed their budgets - called AFE or Authorized for Expenditure amounts. Exhibit 3 reflects the forecasted cost growth for MRL Segment 2 construction and systems contracts, stratified by contract type.

Estimate at Completion (EAC)
As of 1/31/1995
Dollars in 000's

	Tunnels	Facilities	Systems	Total
Award Value	$ 236	$ 379	$ 94	$ 709
Current EAC	$ 292	$ 431	$ 103	$ 826
Percentage Growth	24%	14%	10%	17%

Note 1> Tunnel contracts: ALL THREE CONTRACTS are forecast to exceed their AFE
Note 2> Facilities contracts: 4of 10 contracts are forecast to exceed the AFE
Note 3> Systems contracts: 3 of 20 are forecast to exceed their AFE

Exhibit 3

Exhibit 3 shows some distinct cost growth differences for Tunnel and Facilities contracts. Both types are forecast to exceed their 10 percent contingency, and therefore their AFE. This type of information would be beneficial for the Board's management reports (when trends are reported and variances explained), but it currently is not presented. The detailed calculations of the EAC must include the following data inputs:

- What risks are included
- What amounts are forecast
- What is the probability these risks occur for the forecast amounts

These are all valuable pieces of information to be presented to the Board. It is understood that some of this information should be kept confidential so the contractors are not aware of the MTA's estimates of particular risks, but a vehicle to pass the message appropriately is necessary.

3.3 Contingency Reporting

A crucial Board monitoring instrument is the level of contingency that exists in the project. Contingency, in its purest form is the difference between a contract's budget and its awarded amount. Contingency has two classifications - Allocated and Unallocated. Allocated contingency is the amount ear-marked to fund projected cost growth for a specific purpose or contract. Unallocated contingency is the remaining amount of contingency not ear-marked for a specific purpose. The MTA established a segment of

allocated contingency for each project as part of the contract set-up procedure. Generally this segment of contingency is set at 10 percent of the contract award amount - no matter the type of contract. Change orders to a contract are then charged against the specific contract's contingency amount.

The Board management report reflects the current unallocated contingency, but not the remaining allocated contingency. The progress report also does not list the contingency trends over time, showing how it has been utilized or how its utilization relates to project progress. By reviewing and performing data analysis of the monthly detailed cost reports, it is possible to determine the unallocated contingency trend, but not the total contingency trend. The unallocated contingency has decreased to 10 percent of its original amount, while the project has only been half completed.

3.4 Risk Assessment and Reporting

The concept of risk assessment is identifying what cost growth items can be forecast for a specific type of contract. Certain contracts such as tunnels have a different risk exposure than do systems contracts. The timing of risk events occurring is also different between contract types. For example, a tunnel may experience a Differing Site Condition (DSC) at any time during the tunnelling which may result in a change order, while a station contract may only be exposed to the risk of a DSC while excavation is on-going. These factors should all be considered when setting the allocated contingency for a contract - not just accepting a 10 percent allocated contingency.

4.0 Recommendations for Management Reporting

4.1 To be effective, Management Reporting must address the primary cost and schedule characteristics of the program to facilitate project planning, monitoring and analysis (Exhibit 4).

The Management Reporting characteristics are as follows:

Cost Characteristics	Schedule Characteristics
1. Costs committed	1. Original Program Baseline or schedule
2. Costs incurred	2. Current Program Baseline or schedule
3. Original budgeted contingency	3. Original float (available time in the schedule)
4. Budgeted contingency utilized	4. Current float
5. Budgeted contingency available - allocated to specific contracts	5. Pending schedule issues and float impact estimates
6. Budget contingency available - unallocated (general owner's contingency)	6. Probable schedule issues and float impact estimates
7. Pending cost issues, their probability and their cost estimates	7. Potential schedule issues and range of float impact estimates
8. Probable cost issues, their probability and their cost estimates	
9. Potential cost issues, their probability and their range of cost estimates	

Exhibit 4

These Progress Report characteristics must be reported as trended information with the historical information and future projected or forecasted information provided. This complete (trended) presentation will allow comparisons and analysis by the Board (top management) that will facilitate accurate decision making. Overall, a valuable set of Progress Reports must be written and organized in a concise, clearly understandable fashion that reflects the true reality of the Program's status, so that open and honest discussions can ensue to resolve critical issues in a timely and cost-effective manner.

4.2 **The Management of the MTA must show willingness to have the full and true cost picture of each project depicted in confidential periodic reporting to the CEO.** The CEO should then report to the Board on such critical but sensitive issues, in a manner feasible to protect MTA's interest in its relations with its contractors and consultants.

4.3 **We recommend that Management Reporting be refocused and oriented toward Exception / Variance reporting.** Reporting that highlights risk areas as well as unfavourable variances and trends will greatly enhance the value of the reported information. Exception-oriented reporting provides greater visibility of potential risks and problems. When too much information is presented, important areas lack necessary visibility and potential problems can go unnoticed and therefore unresolved. It is also important to put these variances from plan in perspective, so some general progress data should also be reported.

4.4 **Enhance the report by transforming the contents of the report from a compilation of data, to valuable information useable for decision making, through data analysis.** Data analysis is the process of taking the raw historical facts of the project and comparing and contrasting this data to the future forecasts and historical results of similar projects, to identify trends, to anticipate problems and to develop information to assist in decision making. The information created from the data analysis process will facilitate early identification of problems and viable alternatives. The problems identified may have cost, schedule or technical impacts which require special resources to resolve. Enabling the early identification of problems and their causes, as well as the needed resources and actions to resolve them, is an essential element for the Board.

4.5 **Once potential problems have been identified, an action plan should be developed by the CMs, EMC and the MTA Staff that proposes solution options, assigns action steps and timetable requirements to specific individuals to carry out the options.** Proper Board Reporting requires documentation of necessary actions, and once determined, they must be communicated to the CEO, Construction Committee and the Board for their determination of what is the correct action step to execute, to meet the global needs of the program. The reporting should provide a mechanism for monitoring the performance of the action steps and their effectiveness.

4.6 **The Progress Report (Executive Report Rail Program Status) should be inclusive of narratives and schedules that identify program issues that are not proceeding according to their planned requirements.** The information presented should "segment" the construction data into valuable elements (cost, schedule, quality, safety, public affairs) to educate and inform the Board of the Program's current and near-term critical issues. The information included in these "Progress Reports" should facilitate the MTA Board with their decision making processes.

5.0 Recommendations for Specific Cost and Schedule Project Control Reports

5.1 **We recommend hat the MTA revise the Executive Report-Rail Program Status, PMSR and Project Cost Reports utilizing the recommendations listed in this chapter, and mandate their prompt (10 days after close of period) production.** Each report should be modified to more effectively meet the needs of its users including prompt, timely production and release. The emphasis in these reports should be shifted from providing a history of project results to highlighting existing and potential problems. The amount of information and level of detail should be organized along hierarchical and functional lines to increase its effectiveness.

5.2 **We recommend the PMSR be restructured to expedite its preparation.** The PMSR is being produced too long after month end to be a valuable management tool. The preparation and distribution could be expedited if the monthly report was reduced to the essential, desired items of the report recipients. The quarterly FTA report would be produced using the new PMSR as the base. A survey of which sections or pages of the PMSR are required by the recipients should be taken. The necessary data should be retained in the monthly PMSR, and the "extra" data not being utilized on a consistent basis would be removed. This reduced report scope - to only those sections wanted to manage the project - will expedite its production, so the report can serve its purpose - to facilitate management decisions.

5.3 **We recommend the progress <u>reports reflect trend data for each of the cost and schedule characteristics identified in Exhibit 1</u>, both numerically and graphically.** By tracking the developments of these project control characteristics initially in the reports by Project and subsequently by contract, the Board will be able to adequately monitor progress. For pending, probable and potential cost and schedule issues it is important to identify the probability associated with the event occurring (e.g. the likelihood of a change order for the DSC is 40%) and the cost magnitude or range for the risk (e.g. the DSC change order will be for $250,000 to $400,000). The basis for these estimates of probability and value should be communicated as well, so they can be monitored over time to assess the process validity. However, some information should be kept confidential so relations with contractors and consultants are not jeopardized. The use of oral reports and summary schedules may assist.

5.4 **The set of Progress Reports received by the Board should provide a broad overview of construction activities to date and for the current period.** Emphasis should be placed on those items representing current or potential problems or concerns. While concise, the report should identify:

1. Progress expected for the previous period
2. Progress accomplished during that previous period
3. The variance of progress should be explained and action steps identified to mitigate the unfavourable variances identified. Included in the action steps are to be proposed solution alternatives that include assignments and timelines to accomplish the variance mitigation necessary
4. The progress expected for the next period
5. A discussion of "problems or concerns" that are pending or probable and the proposed action steps or alternatives to combat those problems [with assignments and timetables]
6. A discussion of the "problems or concerns" that are potentially going to impact the MTA (not as definitive as the pending or probable items) and the proposed action steps or alternatives to combat those problems

5.5 **The Executive Report Rail Program Status (Board Progress Report) should identify critical issues with short narratives and summarized schedules. Graphical presentations should be used to facilitate presentation to the reader.** The information included should address:

- Cost Growth (current level, pending and probable additions, potential additions-exclusive of the unallocated contingency and a narrative of those items "possible, but remote")
- Schedule Constraints (those project schedules near the critical path and/or having an effect on the critical path, and proposed alternatives to mitigate)
- Significant Change Orders and Claims (their current status, what alternatives exist to resolve the change or what alternatives exist to mitigate their impacts)
- Public Affairs (current actions, planned actions and previous period results)
- Other Current High Priority or High Visibility Issues (the nature of the issue, the action items necessary to address the issue, etc.)

5.6 **The Management Reports should also address the variances and exceptions from the plan through "oral presentations" by the Executive Officer - Construction and the PMs from the**

MTA. The EOC and PMs should be providing this report to the Board, the Construction Committee, the CEO and his designees. The PMs will provide a written summary describing the key management issues, listed above for the Board and the Committee at the presentation. We recommend that these meetings take place at each Board and Committee meeting and once a week for the CEO to keep the parties informed of the progress and problem status of the Program.

By incorporating the recommendations from sections 4 and 5, we believe the MTA will obtain the following benefits:

1. Reliable Estimates at Completion: An earlier more complete sharing of information, between the resident engineer, his PCE, MTA staff and ultimately the MTA Board, will add credibility to forecast cost figures and provide an improved early warning instrument
2. Better-informed MTA Board : Open communication will encourage MTA staff and consultants to share the complete picture of current rail construction issues
3. Superior Cost Management: Open dialogues between the MTA Board, MTA staff and consultants enables the vast experience each group possesses to be directed toward problem solving to mitigate cost escalation
4. Superior Cost Control: Taken together, reliable, timely and more independent cost information will be reported to allow the MTA and its consultants to make better management decisions to control the program.

6.0 Performance Duties of the MTA and the CM Regarding the Project Control - Reporting Function

Project Control - Reporting is a function that is currently performed by the CM. Once the MTA assigns custody of the project budget and schedule to the CM, the CM is responsible for entering, verifying and working with the data residing in the CMS and CCS systems. These systems generate the majority of all graphs, tables and other displays contained in the various reports circulated throughout the MTA.

The MTA currently oversees the function by first performing oversight of the Project Control - Cost, Schedule and Construction Estimating functions who produce the information used in the Project Control - Reporting function. The MTA performs further oversight by reviewing the various reports to ensure compliance with established guidelines.

7.0 Findings Regarding the Program Control - Reporting Function

Project Control - Reporting includes the monitoring activities regarding the budgeting, the cash flows, the contractual commitments management and physical construction progress monitoring. Project Control - Reporting output provides the MTA with the ability to monitor project budgets, commitments, forecasts, incurred costs and expenditures.

A fundamental aim of Project Control - Reporting is to make complete and accurate cost information available for effective construction management. To be a true management tool, Project Control - Reporting must:

1. Capture current construction costs and accurately forecast cost escalation due to potential contract changes and claims
2. Illustrate the amount of project budget that is committed to expenditures at a given time
3. Reflect the anticipated final position of the contract (estimated cost at completion) for cost control opportunities
4. Forecast the cash flow demands of the project
5. Report each Contractor's physical progress relative to expectations and prepare progress reports based on objective measurements.

The current overall responsibility to perform the tasks associated with the Program Control - Reporting function resides with the CM. The MTA is responsible for the oversight of the CM as they perform these tasks.

7.1 The following summarizes the major Program Control - Reporting duties being performed by the <u>CM organization</u>:

1. Co-ordinate report preparation, analyze data, edit content, perform report layout and graphics displays, duplicate and distribute project reports, including the following primary management reports: Project Manager's Status Report; Monthly Project Schedule Report; Monthly Project Cost Report; FTA Quarterly Supplemental Report; Quarterly Construction Performance Report

2. Assist in the co-ordination, development and reporting of cost information for the non-construction cost elements included in the above reports. Examples of non-construction cost elements include design and EMC professional fees and costs, other professional services costs and MTA staff costs
3. Generate a monthly report on CM expenditures and services
4. Provide monthly photographic documentation of project construction progress (including aerial photography where appropriate), maintain a project slide library and provide graphics displays to the field

7.2 The following summarizes the major Program Control - Reporting duties being performed by the MTA organization:

1. Maintain the automated CMS and ensure that CMS practices are implemented and operating on all projects
2. Prescribe the format of all reports and, once the reports are created, review their acceptability and conformance to MTA Program Management standards
3. Review, approve and sign-off on all project control reports prepared by the CM
4. Combine the project control reports provided by the CMs under separate cover for the MTA into the Executive Report Rail Program Status
5. Provide MTA policy directives determining the nature of cost information to be collected, the frequency of collection, the methodology for primary analysis and overall reporting requirements. Ensure that cost reporting is consistent in content and form with cost information being compiled for other projects within the Metro Rail program
6. Summarize all contract actions into Authorization for Expenditure (AFE) documents
7. Rate the CM's ability to provide timely, accurate and complete reports

8.0 Recommendations for Organizational Changes to Project Control - Reporting

8.1 **We recommend that the MTA not assume all Project Control - Reporting tasks from the CM. The MTA should continue in its oversight role subject to the recommended changes included in section 8.0 and in the Cost Control chapter.** Each organization involved in the Rail Transit program for LA County has in-house reporting capabilities. This function is a support function to the overall Project Controls groups within the MTA, EMC and the CMs. **There is a**

Transit program for LA County has in-house reporting capabilities. This function is a support function to the overall Project Controls groups within the MTA, EMC and the CMs. **There is a full discussion with associated recommendations regarding restructuring the Project Controls functions of the MTA, EMC and the CMs in the Project Control - Cost section of our report.** This restructuring would remove the Project Control - Reporting function from each of the entities and centralize the function under the direction of the MTA. Each entity would potentially be providing some resources for the Project Control - Reporting function to the MTA, but the function would not be separate in each entity.

8.2 **We recommend that the MTA develop a Project Controls team comprised of a selected group of individuals from the MTA, the CM firms, the EMC or other consultants.** This Project Control team would also provide the Project Control - Reporting function. We propose a transitional organization structure with the Project Control Team reporting to a Project Control Manager, a Senior Cost Manager and a Senior Schedule Manager mandated to be MTA employees. As a result of this change, the MTA must also amend the CMs and EMC scope of services to eliminate the requirement for a full Project Control - Reporting capability. The CMs and the EMC will be required to provide quality candidates to fill available Project positions when requested by the Project Controls Committee.

8.3 **We recommend that the newly restructured Program Control unit significantly increase their qualifications in finance, accounting and economics.** The majority of the Construction unit has technical training experience in Construction and Engineering. There are a limited number of finance, accounting and economic minded individuals within the Construction unit. It is important to balance the skills and experiences of those individuals who know and do construction and engineering, with those that know numbers and have the conservative mind set that facilitates cost control and accountability.

With these recommendations, we believe the MTA will obtain the following benefits:

1. Qualified Personnel: An ability to mandate qualified personnel are provided and available for the recommended Project Controls Team
2. Time Flexibility: Flexibility to have budget, cash flow, commitment and physical progress information reported in a timely and cost effective manner

3. Improved Cost Control Oversight: MTA Senior Cost and Schedule Managers will assume a more active role in directing specific cost trend reporting (please refer to our recommendations regarding the types of reporting to produce) and assuring that Project Control - Reporting methodologies are uniformly applied
4. Better Project Control - Reporting Quality: Selecting the best available project control candidates from an inter-company pool or external hires will facilitate the MTA's ability to obtain the best skills for the required positions
5. Lower Costs: Eliminating redundancies in project control management, if possible, will save the MTA in consulting fees and Agency expenses
6. Enhanced Communications: By establishing an integrated multi-organizational, project focused team, potential organizational barriers to communication will be removed. More timely and candid Project Control - Reporting information will likely result

CHAPTER XIII
Volume B

SAFETY

1.0 Nature of the Function

The objective of a safety program is to ensure the safety of employees, contractors, the riding public, and the public at large during the construction and operation of the transit rail system. To be effective safety must have the complete support of top management. Field supervisors will sometimes neglect safety in their haste to complete their work on time and within budget. Only when supervisors are convinced by top management that safety is equally important as production will the benefits of an effective safety program be achieved. An effective safety program must instill a sense of safety consciousness in every project participant.

2.0 Our Approach

Our review of the safety function consisted of interviews, review of previous internal and consultant reports, including the review recently performed by Alpha Engineering (Alpha) at the MTA's request, site visits to selected MTA tunnels and stations, analysis of relevant safety data, and visits to four other rail properties. These properties were:

- Bay Area Rapid Transit (BART)
- Metropolitan Atlanta Rapid Transit Authority (MARTA)
- Tri-Met (Portland)
- Washington Metropolitan Area Transit Authority (WMATA)

For purposes of analysis we focused on MRL - Segment 2, since this was the most active segment with sufficient history and data available to be meaningful. Also, we performed our analysis based on the organization structure, management, and staffing in place as of August, 1994. Numerous changes have been made since that time and are addressed, if appropriate.

3.0 Issues of the Function

The MTA does not have a comprehensive Safety program centralized in one document. The guidance and direction for safety reside in several documents, but do not encompass all aspects of the safety function:

- System Safety Program Plan (SSPP) - guiding document for system safety
- Construction Safety and Security Manual - issued to contractors

The primary responsibility for construction safety rests with the contractors. Each contractor must have a qualified safety engineer on site during construction and must provide a written safety program plan that ensures appropriate codes, orders and regulations will be followed. This plan is reviewed and approved by the MTA Safety group. To enhance the program further, significant MRL - Segment 2 contracts, primarily tunnels and stations, include an incentive clause to reduce the incident rate, or lost time accidents cases per 200,000 hours of worker involvement, below a predefined base value or "target incident rate". This program was based on a successful Safety Awareness Program (SAP) developed by WMATA.

Prior to November 21, 1994, the CM had responsibility for monitoring and enforcing the safety program on behalf of the MTA. These responsibilities included:

- On-site safety inspections and documentation
- Monthly contractor safety audits
- Contractor safety program review

These services were performed primarily by Field Safety Inspectors assigned to each contract. The MTA did oversee the safety monitoring effort performed by the CM. Since November 21, 1994 the MTA has assumed the CM safety functions. CM employees have been seconded to the MTA to provide the necessary resources. The MTA is currently recruiting to permanently fill these positions.

Construction Safety should be closely coordinated with Construction Risk Management. Construction Risk Management is responsible for determining appropriate levels of worker's compensation insurance to adequately cover anticipated claims. Construction Risk Management is also responsible to process these claims and to report on loss experience. These

last two functions, processing and reporting, have been outsourced by the MTA to a Risk Mangagement consulting firm, Mass Transit Group. Traditionally, construction risk management also perform loss control functions, that is they supplement field safety inspectors to identify current and potential problems, advise on safety improvements, and record and follow up on nonconformances of safety standards. While field safety inspectors concentrate on construction safety, loss control consultants focus on minimizing claims and financial losses.

Currently, the MTA's Risk Management group does not perform loss control functions. Additionally, Construction Safety and Risk Management do not coordinate their activities, but work independently of each another. These responsibilities are described in greater detail in Chapter XVI, Risk Management, of this Volume B.

4.0 Overall Conclusion

The MTA measures the performance of their safety program using the widely accepted standard of incident rate, or lost time accidents cases per 200,000 hours of worker involvement. Based on this measure the MTA safety program is successful. The program has achieved an incident rate of 3.1 on MRL - Segment 2 compared to the national average of 6.1. This excellent performance is the result of significant improvements made since MRL - Segment 1.

However, other properties have achieved greater success at lower cost. WMATA in particular enjoys a 2.8 incident rate using approximately 50% of the resources. Incident rate comparisons are shown below:

	Incident Rate (IR)
National Average	6.1
MRL - Segment 1	10.4
MRL - Segment 2 (as of September, 1994)	3.1
WMATA (since SAP)	2.8

Our review identified three primary factors which account for why the MTA has not been as successful as is WMATA at a significantly lower cost:

a. **Top Management Support:** MTA top management has not shown clear evidence of its support for the safety program as demonstrated by its actions.

b. **Roles and Responsibilities:** Roles and responsibilities of agency staff, consultants, and contractors are unclear, resulting in disagreements in safety philosophy, objectives and execution.

c. **Resource Leverage:** The Safety group has not sufficiently leveraged its responsibilities through agency staff (e.g., construction risk management), consultants (e.g., REs, QC) and contractors (e.g., safety engineers) in a collaborative fashion.

Additionally, a broader set of **performance incentives and measures** could be used to enhance the safety program further.

Each of these four matters will be addressed in turn.

5.0 Top Management Support

Top management support can be demonstrated by several factors including reporting, independence, budgeting, and support of Stop Work Orders. By these measures, top Management has not demonstrated strong support for safety.

The importance of any function within an organization is determined in part by where the function reports in the organization. The System Safety Program Plan acknowledges this fact by stating in Section 3.0: "Safety functions are to report to a level of management which provides sufficient authority and organizational freedom to assure that appropriate action is taken to resolve conditions adverse to safety."

However, until recently, the MTA had not followed the stated policy as intended, which is illustrated as follows:

- The Director of Safety reported to the Executive Vice President of Technical Operations who reported to the Executive Officer of Construction. Safety had less clout than Project

Managers who report directly to the Executive Officer of Construction and have primary responsibility for cost and schedule. Therefore, sufficient authority was questionable.

- Additionally, since the CM was responsible for both managing the performance of the work as well as monitoring safety, independence of the safety function was questionable. To assure an independent assessment of work practices, the organization monitoring safety performance must be fully independent of the CM.

As part of the October 1994 agreement with the FTA to restore funding, the MTA elevated reporting of the Director of Safety directly to the Executive Officer of Construction and assumed the CM safety functions. We concur with these changes. This level of reporting gives the safety group sufficient clout to be able to influence MTA project personnel, consultants and contractors and the independence of safety is restored.

However, the budget to support safety staffing is still controlled by project management. Therefore, project management exerts an inordinate amount of influence over safety. With limited resources, project management makes tradeoffs in staffing between safety and other project areas, such as construction management, project control, and engineering.

Anecdotal evidence exists to suggest that management has not always firmly supported Stop Work Orders issued for safety reasons. During interviews, MTA and CM employees stated verbally that Stop Work Orders have been ignored in the past by contractors focused on maintaining project schedule. If the MTA does not deal firmly with such infractions, make its position known and enforce it, then its credibility with its consultants and contractors will be undermined. Even if a Stop Work Order has questionable merit, which we deal with in the next section, construction management must support them unequivocably until a final determination of merit is made and a release can be issued. Contractors must understand that Stop Work Orders are not negotiable.

Each of these factors, reporting, safety independence and budgeting, and support of Stop Work Orders, are indicators of top management's commitment to safety. Sending strong signals to consultants, contractors and MTA personnel is critical to making the safety program effective. Therefore, we offer the following recommendations:

Recommendation #1: The MTA should complete the transfer of Safety to the MTA. To ensure an independent assessment of safety practices, the Safety function needs to be fully independent of the individuals or groups directly responsible for performance of the construction work. Consequently, this function must be performed by the MTA staff, not consultant's staff seconded to the MTA.

Recommendation #2: The MTA should take advantage of the recent assumption of construction safety to assess the skills and capabilities of the MTA safety function. Strong leadership of the Safety organization will be critical to its continued success.

Recommendation #3: Budgeting for the safety function should be done by the Executive Officer of Construction, independent of individual project budgets. Staffing for safety should be based on the number of people required to adequately perform the responsibilities of the function, and not viewed as discretionary support. Fiscal independence is as important as the reporting independence recently addressed by the MTA. Additionally, this change in budgeting responsibility is consistent with the changes in reporting responsibilities already noted.

Recommendation #4: The MTA must firmly enforce all Stop Work Orders issued for safety reasons. The MTA must send out a consistent message that lapses in safe work practices will not be tolerated. Management support of those individuals who issue Stop Work Orders, and advertising of such support throughout the construction organization (MTA, consultants and contractors), is the evidence required to demonstrate management commitment.

6.0 Roles and Responsibilities

The roles and responsibilities of the safety function are not clear. Some within the MTA believe the role of safety should be enforcement, issuing citations to contractors violating safety rules. Others believe safety should work in an environment of safety awareness through collaboration with contractors to assist them in their safety efforts and monitor their performance. These two approaches to safety, enforcement versus awareness, have different consequences. Enforcement requires greater staffing to have sufficient visibility to act as a deterrent. Awareness only requires a periodic presence. Enforcement implies safety inspectors have authority to dictate how the contractor behaves, while awareness only influences contractor behavior. Enforcement

may also result in more liability for the MTA if delays in project schedule or increases in cost are blamed on safety inspector interference.

The confusion in roles and responsibilities highlighted above is the consequence of having no unified safety program plan articulating the official position of the MTA regarding safety. Roles and responsibilities become subjective, resulting in inconsistent behavior or application of processes. Although, the MTA is currently developing a safety program plan, such plan is only available in a draft and unapproved form. Also, this draft plan does not sufficiently address safety roles and responsibilities.

Confusion also exists in responsibilities and how they are executed. For example, until recently, no written procedure existed to provide guidance on the conditions or process for generating a Stop Work Order. Issuing Stop Work Orders for safety reasons was left up to the discretion of the field safety inspectors. With no specific guidelines outlining the conditions and circumstances under which a Stop Work Order should be issued, contractors and others could "debate" a Stop Work Order to attempt to change the field safety inspector's mind. This situation could put construction management in an awkward position as they debated enforcing a Stop Work Order that might have questionable merit but could significantly impact project cost and schedule.

A new Suspension of Work Notice procedure was issued December 16, 1994 and revised on February 20, 1995. One of the five conditions for when work could be stopped was: "Life threatening or unsafe conditions." However, this stated condition is too vague to eliminate confusion in the future.

To better clarify roles and responsibilities, the following two recommendations are made:

Recommendation #5: The MTA must develop a comprehensive safety program plan. The plan should outline specific roles and responsibilities of safety personnel, the contractor, the CM and in particular their resident engineers, MTA Construction Management, and other important positions involved in the safety effort.

Additionally, guidelines for issuing safety violations (CS-50s) and Stop Work Orders must be defined. Finally, the safety philosophy, enforcement versus awareness, must be articulated and

MTA top management must be actively involved in implementing all of the above when reviewing and approving the draft safety program plan available.

***Recommendation* # 6**: The MTA's Suspension of Work Notice procedure must be revised to better specify the conditions and circumstances under which work can be stopped. "Life threatening or unsafe conditions" could be interpreted to include minor safety violations. Conditions need to be more specific, otherwise conflicts may arise over interpretation.

7.0 Resource Leverage

The overall construction safety organization (MTA plus CM seconded employees) has a disproportionate number of managers compared to field inspectors who spend most of their time on job sites. The following table of approximate construction safety staffing in August, 1994 illustrates this:

	Construction Safety		
Position	MTA Staffing	CM Staffing	Total Staffing
Management	3.5	1.5	5.0
Related Support	1.0	1.0	2.0
Total Management	4.5	2.5	7.0
Field Safety Inspectors	0	4.0	4.0
Related Support	1.0	1.0	2.0
Total Field	1.0	5.0	6.0
TOTAL SAFETY	5.5	7.5	13.0

The relatively large numbers of managers is due primarily to how safety was organized. Within the MTA, construction safety (safety during the construction process) was organized as part of a larger safety group also responsible for system safety (safety of the rail system constructed). The CM mirrored this structure. Additionally, MTA Safety Managers were assigned in part to oversee the activities of the CM's Safety Engineers. This organization structure resulted in less than 50% of safety resources being in the field at job sites. By contrast, more than 75% of WMATA's safety resources are in the field.

Also, the MTA has not taken advantage of other MTA personnel, consultants, or contractors to make the program cost effective. For instance:

- In many other properties, loss control consultants from a construction risk management group or insurance provider supplement field safety engineers. As a team, loss control consultants and field safety inspectors work with construction personnel to identify current and potential problems, advise on safety improvements, and record and follow up on nonconformances of safety standards. While performing similar functions, loss control consultants and field safety inspectors come from different perspectives. Loss control consultants focus on financial losses, while field safety inspectors focus on construction work practices. The MTA does not have loss control capabilities.

- The MTA does not take full advantage of other field personnel such as Resident Engineers and Quality Control inspectors. Other properties train Resident Engineers and inspectors in safety matters and view them as an extension of the safety department, routinely involving them in safety reviews.

We offer the following recommendations to leverage safety resources:

Recommendation #7: Now that the MTA has assumed responsibility for construction safety, they should consolidate Safety management staffing and associated support. The duplicative positions between the MTA and the CM should be eliminated. Field safety inspectors and their associated support, however, should not be reduced. The MTA should be absolutely certain the Safety function is running smoothly and effectively and that a safety mindset is in place before reducing the headcount of safety inspectors.

Recommendation # 8: The MTA should develop a loss control group, reporting to the Risk Management group. Loss control consultants (either employees or outside consultants) would provide a more financial perspective to construction safety. Loss control consultants should work closely with Construction Safety to better understand the relationship between field safety practices and experience, and actual losses incurred.

Recommendation #9: The MTA should better coordinate safety with other functions key to safety. Transferring the construction risk management function into the Construction group

should be considered, as was developed in Chapter V of Volume A. This arrangement would facilitate Construction Safety and Construction Risk Management collaborating together. Safety should also work more closely with REs and Quality Control. These functions are responsible for ensuring contract specifications are satisfied by contractors, including safety requirements. With additional training and coordination, REs and inspectors can become an extension of the safety department.

By leveraging all resources available, other properties have been able to rely on fewer dedicated safety personnel. This is made possible from the strong management support establishing a well entrenched safety mindset. As more personnel from the agency, consultants and contractors reinforce the safety message, fewer dedicated safety personnel are required. Again, management commitment and an organizational safety mindset must be in place before performing the safety function with the fewest people possible.

8.0 Performance Incentives and Measures

As stated previously, to date, the MTA's incidence rate on MRL - Segment 2 is good. This is due in part to the contractual incentives given to contractors to minimize lost time accident cases. The current Safety Awareness Program (SAP) incentive is based on a predefined base value or "target incident rate" (TIR). The incentive amounts to .05% of the contract value for each full decimal fraction (0.1) that the actual incident rate is reduced below the TIR up to a maximum of 1% or $500,000 thereof, whichever is less. Contractors focus on minimizing incident rate, as it directly affects their profitability.

The amount ultimately paid by the MTA in incentives is offset by premium refunds from the insurance program due to a favorable safety record. However, the amount refunded, may or may not cover the SAP incentive. One property visited ties their SAP incentive to the actual premium savings. Savings are shared with contractors based upon a formula outlined in the contract.

The current SAP incentive has no contractual requirement for contractors to share a percentage of the final award with the workers whose safe performance made the award possible. The sole

incentive is for contractor management who will be rewarded for the overall safety of the contract. Therefore, the program does not provide incentives to individual workers.

With respect to individual workers, another important safety measure, the recordables index, or number of doctor cases per 200,000 hours of worker involvement, shows the MTA still needs to improve significantly since it is almost double the national average:

	Recordables Index
National Average	13
MRL - Segment 1	42
MRL - Segment 2 (as of September, 1994)	23

Consequently, we offer the following recommendations 8 and 9 to improve the safety performance incentives, which are aimed to further improve safety. Finally, our recommendations 10 and 11 are made to improve the financial performance of the safety function and its measure.

Recommendation #10: Modify future construction contracts to distribute a percentage of the SAP award to workers via cash distributions, awards, drawings or in similar ways. Not only will this provide additional incentives to workers, but it can be used to promote safety throughout the contractor organization.

Recommendation # 11: Include target rate incentives for recordables index in future construction contracts. Recordables index should be included in the overall formula for the total SAP award. This will encourage greater attention on recordable cases from contractors.

Recommendation # 12: Consider alternative SAP incentive structures to more closely tie payments to contractors with refunds of premiums. This may lower the financial risk to the MTA and better control cash flow.

Recommendation #13: Consider introducing financial performance measures such as overall safety program cost (personnel, incentives, insurance premiums) relative to some measure of

construction activity. This broader measure should highlight the effectiveness of additional personnel, contractor incentives, etc.

9.0 The Alpha Report

The conclusions of the Alpha report, which we understand the MTA might consider, recommended staff reductions of safety inspectors. We do not concur with this recommendation. The MTA should be absolutely certain the Safety function is running smoothly and effectively and that a safety mindset is in place before reducing the headcount of safety inspectors. In light of the changes needed in organization, roles and responsibilities, and performance measures, we believe reductions of field personnel would be premature at this time. The Project Management Oversight Consultant, Hill International, Inc., also cited field staffing concerns in their "Spot Report #3 - Safety Review", dated October 13, 1994. The MTA would be better served to focus on improving the Safety function before transitioning to a leaner organization in the future.

10.0 Transition Plan

While the MTA has looked to WMATA to model its own program, several basics must be in place before fully adopting the WMATA organization structure and realizing similar personnel efficiencies. The MTA should focus on these items over the next one to two years as it transitions to this new safety structure:

- Demonstrate clear evidence of top management support for safety
- Develop safety consciousness through the construction organization (MTA, consultants and contractors)
- Develop the skills and leadership of the safety organization
- Develop and implement a comprehensive safety program plan
- Develop loss control capability within Risk Management
- Develop strong teaming between the Risk Management and construction safety functions, possibly by transferring Construction Risk Management into the Construction Division

- Generally leverage, for the benefit of safety, all resources available, such as resident engineers or quality control inspectors

CHAPTER XIV
Volume B

QUALITY

1.0 Nature of the Function

Quality in construction is a structure of interrelated, supporting elements all working together to constantly encourage and verify quality. These elements are policy, management, system, assurance, and control.

The process begins with top management, who sets overall quality **policy** and communicates its importance throughout the organization in a consistent manner. 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 and ensure that quality policy is understood, implemented and maintained throughout the organization. Specifically quality policy is: "The overall quality intentions and direction of an organization as regards quality, as formally expressed by top management."[1]

The quality process is implemented by Quality **management**. The Quality department has the responsibility and the authority to ensure that quality policy is implemented and maintained. Maintenance includes documented review of the policy at appropriate intervals to ensure that it remains suitable and effective. Specifically, quality management is: "That aspect of the overall management function that determines and implements the quality policy."[1]

The Quality department designs and executes an overall quality **system** encompassing organization structure, processes, procedures, and resources working together to ensure quality in all aspects of design, construction, fabrication and installation. The quality system includes quality standards and appropriate checks and balances. For example, personnel responsible for ensuring quality should be independent of those having direct responsibility for the work being performed. Specifically quality system is: "The organizational structure, responsibilities, procedures, processes, and resources for implementing quality management."[1]

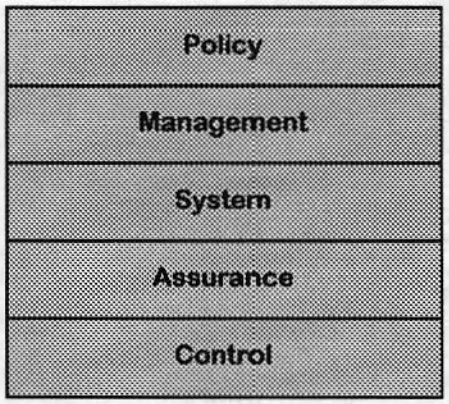
Two important functions within the Quality department dedicated to quality implementation are Quality Assurance and Quality Control. Quality **Assurance** designs the appropriate checks and balances into specific processes and procedures, verifies that developed processes and

procedures have, in fact, incorporated these design elements, and ensures that processes and procedures are being followed as intended. Specifically quality assurance is: "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."[1]

Quality **Control** provides the continual inspection of completed or partially completed work to confirm the quality standards set have been met. Measurements or inspections are made to ensure that a product meets the quality standards determined by QA. Products may be design drawings or specifications, manufactured equipment, or constructed items. Specifically quality control is: "The operational techniques and activities that are used to fulfill requirements for quality."[1]

Each element of the quality process builds on the previous one. This supportive relationship is shown below:

Quality Process



We conducted an extensive review of the quality function. Our analysis consisted of interviews, review of previous internal and consultant reports, site visits to selected MTA tunnels and stations, site visits to five other rail properties, and analysis of relevant quality information. For purposes of analysis we focused on MRL - Segment 2, since this was the most active segment with sufficient history and data available to be meaningful.

[1] "Quality Management and Quality Assurance Standards -- Guidelines for Selection and Use," ANSI/ASQC Standard Q90 - 1987, American Society for Quality Control, Milwaukee, WI, 1987.

To assist us in our evaluation of Quality, we conducted a Quality Benchmarking Survey of three other rail systems to understand how they have addressed the issues the MTA faces. These three properties are a subset of the five properties visited during our review. The three were selected on the basis of their relevance to the MTA and the apparent effectiveness of their quality processes. The three selected were:

- Bay Area Rapid Transit (BART)
- Washington Metropolitan Area Transit Authority (WMATA)
- Metropolitan Atlanta Rapid Transit Authority (MARTA)

Overall, the MTA's documented quality policies and systems appear sound. The MTA has eagerly incorporated policies and systems prescribed by the FTA or used successfully at other properties. However, the execution of those policies and systems can be improved.

Top management has not been firmly supportive of quality policy as demonstrated by their actions. The Director of Quality reported lower in the organization than Project Managers responsible for cost and schedule. Stop Work Orders are seen to be "negotiable" at times. Quality staffing was reduced even as construction activity was increasing. The MTA must send out a consistent message that quality is vitally important. Management support of those individuals who issue Stop Work Orders, support of appropriate levels of quality staffing, and advertising of such support throughout the construction organization (MTA, consultants and contractors), is needed to demonstrate management commitment.

The systems in place to manage quality can also be improved. Past Project Management Oversight Consultant reports have pointed out that improvements have been made in the tools used to manage quality processes such as Nonconformance reporting (NCRs), Requests for Information (RFI) tracking, and submittal tracking. However, those tools show the average time to resolve issues or receive information is slow, hindering the ability of the construction and quality groups to make decisions quickly and efficiently. Some key performance measure indicators are:

Support Process	Measure	Value
Nonconformance Reports (NCRs)	% of total NCRs open	42%
Requests for Information (RFIs)	Average RFI turnaround time	21 days
Submittals	# of AFRs due to submittal problems	14
Audit Finding Reports (AFRs)	% of total not resolved within 45 days	31%

The MTA has recently initiated improvements in the quality function. We support these efforts and believe positive changes are being realized. We believe the elevation in quality reporting has brought greater attention to quality issues as evidenced by improvements in some of the indicators mentioned above. The recent recruitment and hiring of additional personnel for understaffed quality positions should enhance QA's ability to monitor quality processes and activities. Although we agree the MTA should assume all responsibilities of Quality Assurance, we do not believe they should assume responsibility for Quality Control. QC must remain a production function.

Recently, procedures have been initiated or revised to strengthen quality process controls. For instance, a new Suspension of Work Notice procedure was written in December, 1994 and the Control of Nonconforming Items procedure was revised in January, 1995. These enhancements are positive steps in improving the quality function

The balance of the Quality section describes the overall background of the quality function at the MTA and then discusses our findings and recommendations within each element of the quality structure; policy, management, system, assurance and control.

2.0 Issues of the Function

This section provides an overview of the quality function at the MTA. Specifically, each quality element is discussed.

Quality Policy

The MTA's Quality Program Manual is the guiding document for quality. It consists of two parts, Quality Policy Statements and Quality Assurance Program Manual. The MTA quality policy is documented in the Quality Policy Statements. In part the policy states: "It is the Policy of the Rail Construction Corporation (RCC)[2] that projects be planned and conducted with the highest regard for quality and under the purview of an effective Quality Assurance Program. Project programs must define quality goals and objectives, specify quality related activities and indicators, and assign responsibilities for ensuring that the activities are conducted and that the objectives are met."

2. Note, the Quality Program Manual is being revised to reflect changes since the abolishment of the RCC.

Quality Management

Quality management is lead by the MTA Quality department. Prior to November 21, 1994, the department consisted of a Director, two Quality Assurance Managers (Red Line and Green & Pasadena Lines), a Partnership for Excellence in Rail Construction (PERC) Coordinator, a Total Quality Manager, and a Secretary. (The Red Line Quality Assurance Manager has been the acting Quality Director.) Since November 21st, the Quality Assurance and Quality Control management functions of the CM have been seconded to the MTA. These two groups now report into the MTA Quality department, but are still seconded employees.

Quality System

The quality system is documented in the Quality Assurance Program Manual. The manual outlines the procedures to be used in 14 processes determined to be critical to ensuring system quality. They are:

1. Organization
2. Quality Assurance Program
3. Design Control
4. Procurement Control
5. Construction/Installation Control
6. Instructions, Procedures and Drawings
7. Document Control
8. Control of Materials, Equipment, Parts, Components and Services
9. Control of Special Processes
10. Inspection and Test
11. Control of Measuring and Test Equipment
12. Control of Discrepant Items and Corrective Action
13. Quality Records
14. Audits

Quality Assurance (QA)

Prior to November 21, 1994, QA was performed by the CM with oversight provided by the MTA Quality department. Since November 21st, the MTA has assumed all QA functions. CM employees have been seconded to the MTA to provide the necessary resources. The MTA is currently recruiting to permanently fill these positions.

Quality Control (QC)

Initially on MRL - Segment 2, Quality Control was the sole responsibility of the contractors. They were required to develop, implement and maintain a Quality Program (Contractor Quality Control Plan) approved by the MTA. They were also responsible for providing personnel to inspect and document the quality of work performed. Inspectors reported internally to contractor project management. This was generally seen by all parties to be ineffective.

In February of 1993, the CM took over responsibility for QC, including inspection. Inspectors reported directly to the CM's Resident Engineers.

In January, 1994, the CM hired a dedicated Quality Control manager. Specialized inspectors (such as mechanical and electrical), geotechnical engineers, and surveyors reported to the Quality Control Manager. Civil inspectors continued to report exclusively to Resident Engineers.

In May, 1994, civil inspectors added an indirect line of reporting responsibility to the CM's Quality Control Manager in addition to their direct reporting to the REs.

On October 3, all civil inspectors began reporting directly to the CM's Quality Control Manager, with indirect reporting responsibility to the CM Resident Engineers.

On November 21, 1994, the Quality Control department management of the CM was seconded to the MTA. Specifically the Quality Control Manager, the Chief Inspectors and the Data Technician were seconded. Civil inspectors, who remained CM employees, continued to report

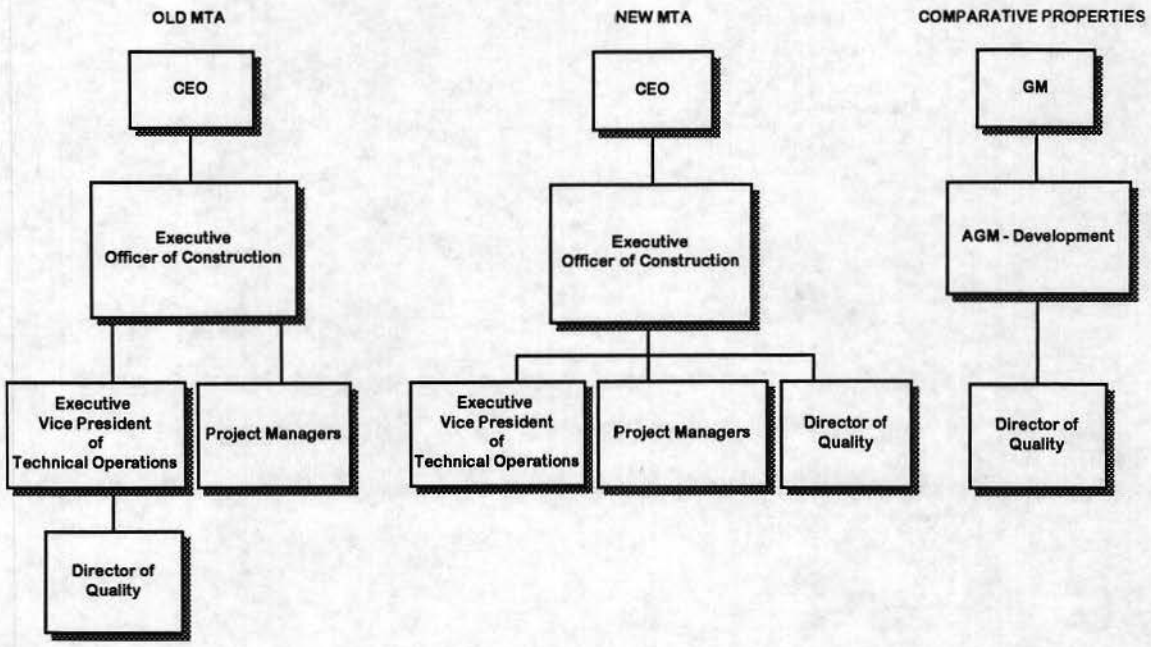
to the Quality Control Manager (who is now an MTA seconded employee), with indirect reporting responsibility to the CM Resident Engineers.

3.0 Quality Policy Findings and Recommendations

Establishing a Quality First attitude starts from the top. If those personnel charged with ensuring the quality of the end product do not believe the are supported by top management, their efforts will be undermined. Similarly, if the organization implicitly prioritizes cost and schedule ahead of quality then the checks and balances designed into the quality system will be upset. Evidence exists that suggests quality has not received sufficient attention from upper management.

One indicator of the priority the organization places on quality is the level the Director of Quality reports into the organization. Until recently, the Director of Quality reported to the Executive Vice President Technical Operations who reported to the Executive Officer of Construction. Quality had less clout than Project Managers who report directly to the Executive Officer of Construction and have primary responsibility for cost and schedule. When project management reports directly to the Executive Officer of Construction, quality has less clout than those primarily responsible for cost and schedule. Recently the Director of Quality began reporting to the Executive Officer of Construction.

This revised reporting relationship is now consistent with other properties surveyed. For all three properties, the Directors of Quality report to an Assistant General Manager (AGM) responsible for development. These AGMs are equivalent to the MTA's Executive Officer of Construction. These comparisons are illustrated on the following page.



We concur with the recent change to have the Director of Quality report to the Executive Officer of Construction. This structure is consistent with other properties and provides the necessary influence needed with project functions.

Another indicator of the value the organization places on quality is the support given when conflicts arise between quality and cost and schedule. Stop Work Orders inherently present such a conflict. Anecdotal evidence exists to suggest quality is not always backed up when work is stopped. During interviews, MTA and CM employees stated verbally that Stop Work Orders have been ignored by contractors in the past. When REs and CM management appealed to MTA construction management for support, the MTA ultimately sided with the contractor. This situation is exacerbated by the fact that no document existed to provide guidance on when Stop Work Orders were appropriate (this issue is addressed in a later section). Whether infighting over Stop Work Orders actually occurred or not, even the perception of such sends a negative message through the organization that cost and schedule can take precedence over quality. Stop Work Orders must be firmly supported by top management, thereby demonstrating a strong commitment to quality.

Recommendation #1: Appeal of Stop Work Orders should be made to the MTA's Director of Quality if it cannot be resolved with the originator of the notice. If the issue cannot be resolved with the Director of Quality, then the matter should be addressed by the Executive Officer of Construction. Beyond this, the contractor still has the option of filing a notice of claim. The

appeal process outlined will ensure the appropriate checks and balances are in place to ensure quality is given utmost priority. The MTA must send out a consistent message that lapses in quality will not be tolerated. Management support of those individuals who issue Stop Work Orders, and advertising of such support throughout the construction organization (MTA, consultants and contractors), is the evidence required to demonstrate management commitment.

4.0 Quality Management Findings and Recommendations

One element of quality management is personnel staffing. Reductions in planned staffing has affected the performance of the Quality Assurance function. Fewer facility and tunnel audits were completed in 1994 than planned (15 vs. 22). The maintenance of the standardized QA checklist was discontinued, which affects the long term ability of the QA department to conduct audits efficiently and effectively.

Quality Assurance auditors periodically monitor contractors and REs to ensure they are following procedures as intended. The number of QA auditors required to perform this function is proportional to the number of contracts outstanding, and their relative size. Each contract must be audited periodically. Larger contracts require greater effort to complete due to the greater amount of activity which must be reviewed. Through 1993, staffing on MRL - Segment 2 increased to accommodate the increasing number and cumulative value of contracts. However, in 1994 staffing decreased by 33% when the number of active contracts increased by 36% as the following table shows. This resulted in fewer audits being conducted than planned. Audit activity did increase overall, but not relative to the number of construction and systems contracts outstanding as shown on the following chart:

Year - Quarter	# of Contracts*	Active Contract Value ($ millions)	# of Auditors	# of Audits*	# of Contracts per Auditor	# of Audits per Contract
1991 - 1	1	53.6	0	0	-	-
1991 - 2	3	178.0	0	0	-	-
1991 - 3	4	216.5	1	0	4.0	-
1991 - 4	4	216.5	1	4	4.0	1.0
1992 - 1	4	216.5	2	5	2.0	1.3
1992 - 2	4	216.5	2	4	2.0	1.0
1992 - 3	7	358.5	2	6	3.5	0.9
1992 - 4	7	358.5	3	7	2.3	1.0
1993 - 1	8	364.7	4	12	2.0	1.5
1993 - 2	9	367.3	6	8	1.5	0.9
1993 - 3	14	406.4	6	13	2.3	0.9
1993 - 4	22	538.5	6	6	3.7	0.3
1994 - 1	26	566.5	5	10	5.2	0.4
1994 - 2	31	663.4	5	12	6.2	0.4
1994 - 3	30	572.4	4	10	7.5	0.3
1994 - 4	30	572.4	4	11	7.5	0.4

* Facilities, tunnels and systems

We concur with the latest targets for staffing of the quality assurance audit function (8 for MRL - Segments 2&3, Pasadena Line, and EMC). As of March, 1995 staffing has increased to six auditors. In light of recent quality problems, the MTA should be absolutely certain the Quality Assurance function is running smoothly and effectively before looking to make it more efficient. Adding resources at this time gives the MTA the opportunity to make necessary improvements in Quality Assurance.

The budget to support quality staffing is controlled by project management. For this reason, project management exerts an inordinate amount of influence over quality. Project management is making tradeoffs in staffing between quality and other project areas, such as construction management, project control, and engineering.

The Quality Assurance group should be budgeted independently of project management. Staffing for quality should be based on the number required to adequately perform the responsibilities of the function, not viewed as discretionary support.

Recommendation #2: Budgeting for the Quality Assurance function should be done by the Executive Officer of Construction, not as a part of individual project budgets. Quality must not be treated as a discretionary support function, but as a critical, integral part of construction. Fiscal independence is important, just as the reporting independence addressed previously. Additionally, this change in budgeting responsibility is consistent with the recent changes in reporting responsibility.

5.0 Quality System Findings and Recommendations

Deployment of quality into the processes and procedures of the construction organization begins with a sound quality system design. The quality system translates MTA quality policy into action. The MTA Quality department is responsible for the overall design of the quality system. This includes the organization structure, the associated roles and responsibilities of each party, and the processes and procedures to be used to ensure a quality product.

The MTA's Quality Assurance Program Manual documents the quality system. The Quality organization uses this document as a basis to define responsibilities in the contracts and develop specific processes to implement the quality system. The Quality Assurance Program Manual presents a comprehensive, well thought out system. In fact, when the FTA was developing their "Quality Assurance and Quality Control Guidelines", the MTA's manual was considered one of the better reviewed and used as the basis for large portions of their document.

Although the quality system as designed appears sound, the execution of the system has not been as effective. There are several deficiencies in the way the responsibilities and processes have been developed from the MTA Quality Program Manual as illustrated by the following examples:

Organization

The Quality Assurance Program Manual states in Section 1, paragraph 4.1:

"The Rail Construction Corporation's (RCC) organization and RCC project organizations, are to be structured in such a manner that:

- Quality is achieved and maintained by those who have been assigned responsibility for performing the work.
- Quality effectiveness is evaluated by persons or organizations not directly responsible for performing the work."

Contractors and the CM are assigned responsibility for performing the work. As described in Section 2.0, Issues of the Function, responsibility for the control element of quality on MRL - Segment 2 was initially the contractor's, then the CM's. Since the CM has responsibility for ensuring work is performed to specifications, it is appropriate the CM has responsibility for Quality Control inspection and management.

Since October 1994 the MTA has taken steps to progressively transfer Quality Control from the CM to its own staff. Secondments of QC management from the CM to the MTA were made on November 21st, with the intention of eventually recruiting to permanently fill these positions. As the MTA does not perform any of the actual work, the MTA should not take responsibility for Quality Control. Quality Control is a production step best performed by those who are responsible for managing the whole production process, consistent with the policy as stated.

The Quality Assurance function is responsible for evaluating quality effectiveness. QA should be performed by an organization not directly responsible for performing work, therefore the CM should not have QA responsibilities. The CM clearly has responsibility for managing the performance of work. To assure an independent assessment of quality activities, the organization performing quality assurance needs to be fully independent of the individuals or groups directly responsible for the work, consistent with the policy stated.

We understand that, since October 1994, this function has been effectively transferred to the MTA, but staffed by CM consultants seconded to the MTA.

Recommendation #3: The MTA should not assume the performance requirements from the CM related to Quality Control. Quality Control should remain a CM function, consistent with the MTA Quality Assurance Program manual. Quality Control is a production step. As such, QC activities strongly impact the overall project schedule and cost. The organization primarily responsible for the control of production, should have control over QC. Splitting these responsibilities may lead to adverse consequences for the MTA such as:

- Increase in change orders and claims as contractors and the CM may attempt to shift blame for schedule delays to the MTA
- Increase in claims as disputes arise over who is responsible for identifying discrepant conditions
- Increase in risk as the CM may not emphasize production quality to the extent they would if they were directly responsible for it

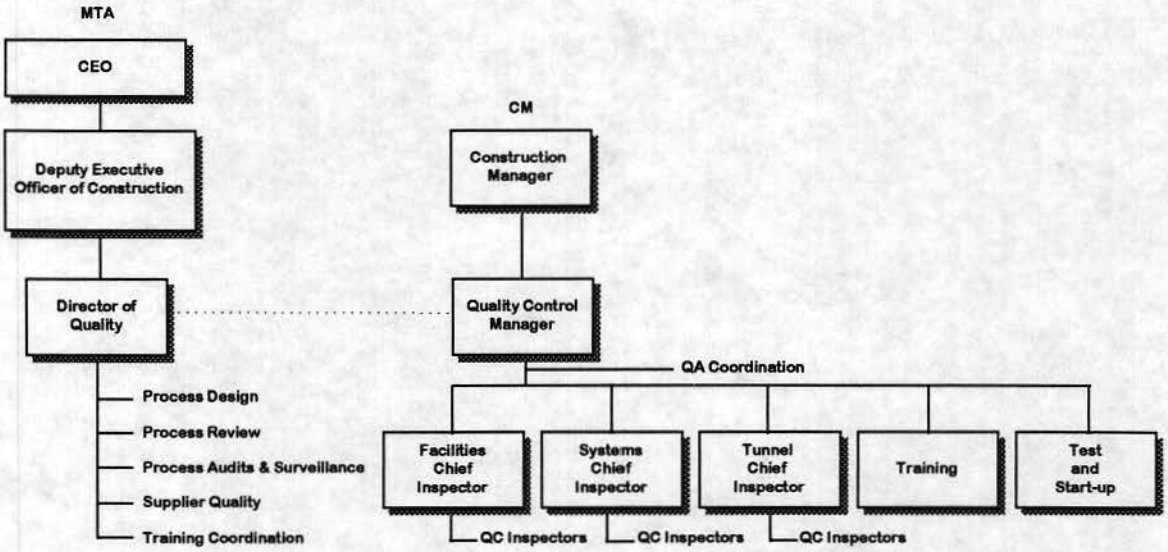
Recommendation #4: The MTA should complete the transfer of quality assurance to the MTA. To assure an independent assessment of quality activities, the quality assurance function needs to be fully independent of the individuals or groups directly responsible for performance of work. Consequently, this function must be performed by MTA staff, not consultant's staff seconded to the MTA.

Recommendation #5: The individual responsibilities between QA and QC need better clarification in the Quality Assurance Program Manual. When both functions resided in the CM, this was less of an issue. Now that the MTA is responsible for QA and the CM is responsible for QC, this distinction is more important.

We recommend the following baseline parameters be followed when establishing the duties of individuals performing QA and QC:

Quality Assurance	Quality Control
Develop quality specifications	Perform and document inspections
Review relevant process and procedures	Review QC procedures, workplans
Monitor processes and procedures	Perform inspector training
Conduct source inspections and audits	Test Witnessing
Define inspector training requirements	QA coordination

The organization recommended for consideration is as follows:



For both organizations, training should be a separate function. Supplier quality should continue to be performed by QA. Now that QA is no longer performed by the CM, the CM will need to have someone coordinate the QA activities which will be occurring on job sites. QC should perform this activity. The QC Manager should report directly to the CM's Construction Manager, with indirect reporting to the MTA's Director of Quality. This means any concerns not satisfactorily resolved within the CM can be elevated to the MTA's attention without fear of retribution.

QC inspectors should be organized by specific inspection expertise. They would report directly to the QC manager who would hire and train inspections, assign inspectors to jobs, conduct inspector performance reviews with input from REs, and provide direction on how and what inspections will be performed. Inspectors would report indirectly to REs, who provide day-to-day direction, specific work assignments, and input into the performance review process.

Design Process and Rolling Stock Audits

Quality Policy Statement (QPS) # 14 states in part: "A comprehensive program of planned and periodic audits is to be established to verify by examination and evaluation of objective evidence that applicable elements of the Quality Program are suitable and have been developed, documented and effectively implemented in accordance with specified requirements."

The EMC has responsibility for the audit of the design process. However, insufficient resources have been assigned to adequately perform this function. One person devotes two-thirds of their time to auditing. In 1994, approximately 16 audits were conducted in total. Of these, 12 were conducted on section designers, not the EMC. The other 4 audits were specific design support processes (design calculations, configuration management, records management, and computer aided design). Engineering disciplines such as architectural, civil, structural, mechanical and electrical were not audited. Without ensuring adequate design control, insufficient quality processes can continue undetected for some time, resulting in design deficiencies. Design deficiencies that are not found until construction or installation, cost substantially more to resolve and correct. Ensuring the quality of the EMC design process is crucial to minimizing more costly construction problems later on.

LTK is responsible for overseeing the manufacturing of rolling stock, including auditing the quality control processes used. Similar issues exist with these audits as those already cited for the CM and EMC.

Recommendation #6: The MTA should assume responsibility for EMC and rolling stock audits. As with the CM, the quality assurance function needs to be fully independent of the individuals or groups directly responsible for performance of work. Additionally, staffing for EMC and rolling stock audits must be considered.

Quality Plans

Section 2, paragraph 3.2 of the Quality Assurance Program Manual states in part: "Consultants, contractors, and suppliers are responsible for developing, implementing and maintaining Quality Programs that meet the RCC Quality Program requirements." Paragraph 5.5 states: "All Project Quality Programs are to be submitted to the RCC Director of Quality or designee for review and acceptance." Section 5, paragraph 4.1 states in part: "Prior to the start of work, construction management consultants and contractors will submit an appropriate Quality Plan which describes the manner in which the organization expects to assure that contract quality requirements are satisfied." (As noted earlier, the Manual is currently being updated to reflect changes since the abolishment of the RCC.)

Since the responsibility for quality control was transferred to the CM in February, 1993, contractors were no longer required to submit a Quality Plan to the MTA. The reasoning was that if contractors were not responsible for quality control or inspection, then there would be no

need for a Quality Plan. Instead, contractors were required to submit construction workplans (CWPs) that documents what work will be performed and how it will be controlled. These CWPs were approved by QC as part of the readiness review process.

Changing the Quality Plan requirement to a workplan requirement sets a dangerous precedent. Contractors receive the message that they are no longer responsible for quality or that the MTA favors a contract that emphasizes schedule and/or cost over quality.

All properties in our benchmarking survey require contractors to submit a quality plan. The plan outlines how the contractor will ensure quality, including planning, control, and problem anticipation and prevention. They also require contractors to perform inspections (separate from CM or owner inspections) and to assign a Quality Control Officer or Manager. A summary of these findings is shown below:

Property	Contractor Quality Plan	Contractor Inspectors	Contractor QC Officer
MTA	No	No	No
BART	Yes	Yes	Yes
WMATA	Yes	Yes	Yes
MARTA	Yes	Yes	Yes

Recommendation #7: Reinstate the requirement for contractors to submit a Quality Plan for approval by the MTA. Additionally, consider adding a financial incentive in future contracts for meeting predefined quality targets (e.g., number of Nonconformance Reports written, or response time to close out Nonconformance Reports or Audit Finding Reports). WMATA has successfully piloted such a program and will now implement it on their future contracts.

Training

When Quality Assurance was still part of the CM's responsibilities, QA developed a training program to upgrade the skills of Quality Control inspectors. The program is comprehensive and structured, incorporating quality certifications and local university courses. Compared to the other properties we surveyed, this level of training is exemplary. The other properties use informal, unstructured programs and require little certification of inspectors.

When the MTA assumed responsibility for Quality Assurance in November, the training program was assumed as well and expanded to include all inspectors (not just the MRL -

Segment 2). This was seen as an opportunity to take advantage of the work the CM had done and to develop consistency of inspection across multiple CMs. Because the CM is responsible for providing skilled, qualified personnel, the delineation of training responsibilities is vague. The responsibilities between the CM and the MTA with regards to inspector training must be made absolutely clear or disagreements could develop if CMs begin to believe training is the MTA's responsibility.

The MTA's Quality Assurance Program Manual does not specifically address the issue of training. The FTA's "Quality Assurance and Quality Control Guidelines" and WMATA's manual, by comparison, has a section devoted to training. Without addressing training in the Quality Assurance Program Manual, conflicts may arise as to how best, or if, to implement a training program. The manual should provide guidance on all quality issues, including training.

Recommendation #8: The Quality department should develop a quality training plan and credential requirements for CMs and contractors. CMs and contractors would be responsible to develop a quality training plan subject to approval by the MTA Quality department. Defining and approving training requirements centrally ensures consistency across CMs and contractors. By adding training as a contractual requirement, the MTA can control the content of the program without assuming the responsibility. The Quality Assurance Program Manual should be revised to address the quality training requirements.

6.0 Quality Assurance Findings and Recommendations

Quality Assurance (QA) emphasizes upstream actions which directly improve the likelihood that Quality Control actions and other production support processes such as submittals, requests for information change orders, design reviews and the like will result in a product 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 are capable of performing tasks related to project quality, ensuring that contractors are capable of meeting and do perform the quality requirements and document the quality effort.

Simply stated, Quality Assurance performs three critical functions:

1. **Developing** the requirements and internal controls necessary to be incorporated into all relevant processes and procedures to ensure product quality
2. **Reviewing** all relevant processes and procedures to ensure these requirements have been incorporated
3. **Monitoring** all relevant processes and procedures to ensure they are being executed according to their design

The analysis of Quality Assurance is organized around these three functions. The time Quality Assurance personnel devote to each is important. A comparison between the MTA and the other properties surveyed is presented below. These figures will be referred to in each respective section.

	Percent of Quality Assurance Department Time		
Property	**Developing** Requirements	**Reviewing** Processes & Procedures	**Monitoring** Processes & Procedures
MTA	5	15	80
BART	5	15	80
WMATA	5	30	65
MARTA	20	60	20

Developing Requirements

After the overall quality system is defined by the Quality department, it is the responsibility of Quality Assurance to develop or help develop the processes and specifications needed to execute the system. Processes must be developed and existing ones scrutinized to ensure appropriate controls are in place to meet overall quality requirements. Quality specifications must be defined. Based on the survey findings shown previously, it appears that Quality Assurance spends sufficient time defining and **developing** appropriate requirements and specifications (5% vs. 10% on average for other properties surveyed). MARTA spends more time updating specifications, a role performed at the other properties by a separate specification engineering group. Much of the requirements development is performed at the start of a line or segment. Once complete, focus shifts to reviewing and monitoring activities.

In reviewing the effectiveness of key quality processes, we identified six that had deficiencies in their controls or development which must be addressed. The processes are: Nonconformance

Reports (NCR), Requests for Information (RFI), Audit Finding Reports (AFR), submittals, specification development, and Stop Work Orders.

Nonconformance Reports (NCR)

Nonconformance reports are written by inspectors to document conditions adverse to construction quality. The Resident Engineer forwards the NCR to the contractor for a proposed disposition. The RE is then responsible to concur with the recommendation, or solicit further input from other groups (e.g., the EMC).

The NCR process has been described in the past by the MRL - Segment 2 Project Management Oversight Consultant (Hill International) as deficient. More recently Hill International has noted substantial improvement. However, several aspects of the process could be improved further.

First, the NCR process has been exclusively controlled by Resident Engineers. REs had the complete authority to approve NCR resolution. REs decided if additional resources were required to evaluate the issues. However, without appropriate checks and balances, critical issues might not surface, such as recurring problems or substitutions which may affect the overall design.

Second, the NCR process has no mechanism in place to ensure the timely resolution of issues. Although NCR aging is periodically tracked, contractors can dispute an NCR indefinitely. As of December 31, 1994, 934 NCRs have been written on MRL - Segment 2, with 389 of these still open (42%). Of the open NCRs, approximately 132 (34%) have been open for more than 60 days. Further analysis shows that during the fourth quarter of 1994, only 20% of NCRs were responded to within the due date assigned by the RE.

When compared to the other transit properties from our survey, the MTA's performance in resolving NCRs is lacking:

Property	Open NCRs (as % of Total Written for Active Contracts)
MTA	42% *
BART	10 - 30%
WMATA	15 - 25%
MARTA	5-10%

* As of December 31, 1994

Timely resolution of NCRs is critical to ensuring product quality. Without resolution, a practice suspected of creating nonconformances can continue and create additional problems. Further work can cover up suspected nonconformances, leading to requests to use as-is or resulting in more costly rework.

Recommendation #9: Report NCR aging status more frequently. Currently, the report is run approximately quarterly on an ad-hoc basis. Quarterly reporting is insufficient to manage open NCRs. Monthly visibility is needed at a minimum to enable continual follow-up with contractors. The MTA is in the process of setting up a monthly reporting cycle.

Recommendation #10: Route all NCRs to Quality Assurance, regardless of type. This gives Quality Assurance the visibility needed in quality issues being confronted in the field. If any resolution appears questionable then further discussion and clarification can take place immediately, allowing a greater range of options to be considered. This recommendation has recently been implemented. The CM's Control of Nonconforming Items procedure was revised January 18, 1995. NCRs are now distributed to: Manager, Quality Control, Project Chief Inspector, Area/Segment manager, EMC project unit manager, MTA Construction Manager, MTA Director of Quality, and MTA Quality Assurance Manager. This changed has been viewed positively by Quality Management as they believe they now have greater visibility into quality issues.

Recommendation #11: Implement mechanisms into the NCR process to hasten resolution. Some possible approaches which may be considered are:

- Delinquent notice - One property surveyed sends a delinquent notice after 90 days to the Assistant General Manager and the Project Manager for follow-up.
- Payment penalty - One property surveyed attaches a payment penalty after an AFR is 120 days delinquent.

- Establish NCR criticality - Link resolution to suspension of work notice process, i.e., if a critical NCR is not cleared by certain time then a stop work order will be issued.

Request for Information (RFI)

During the construction process, issues or questions arise about the design. When this occurs, the RE submits a formal Request for Information to the EMC. The request can be for clarification, approval of design or material changes, approval of plans to repair nonconforming work or use-as-is, etc. Construction depends on this process to receive the information they need in a timely manner. For instance, nonconformance reports issued with a repair or use-as-is disposition must be approved by the EMC. Accordingly, the RFI process is closely linked with the NCR process.

The turnaround time of RFIs has lengthened. The Hill International Project Management Oversight Final Report dated September 30, 1993 indicated that the average age of RFIs was 17 days. Average RFI aging has increased to 21 days in 1994 as shown:

Month (1994)	Average RFI Aging (Days)
January	34
February	21
March	13
April	14
May	8
June	18
July	16
August	26
September	28
October	22
November	25
December	42
Total	21

Unresolved RFIs can have a detrimental impact on quality, cost and schedule as the construction forces attempt to work around effected areas or consider alternative options.

Recommendation #12: Address the turnaround time of RFIs. The RFI tracking system put in place is an excellent tool to collect relevant turnaround time information. The RFI review process needs to be scrutinized to reduce the average turnaround time. One alternative which should be considered is greater on-site resources to answer questions or communicate directly

with field personnel. Other alternatives were identified in the "Report on Requests for Information (RFI) - August, 1994" developed jointly by the EMC and MTA to address the effectiveness of the RFI process.

Audit Finding Reports (AFR)

Every process, or audit subject, evaluated during the Quality Assurance audit results in one of three outcomes; OK, observation, or Audit Finding Report. OK means the process met the requirements of the quality system, that is user of that process conformed to applicable procedures. Observation means an improvement idea was noted, but it is not imperative to implement. An Audit Finding Report means that the applicable procedures were not being followed as intended. These infractions are serious, as they could lead to a lapse in quality. These infractions are documented on a separate Audit Finding Report.

The AFR process has no mechanism in place to ensure timely resolution. Our survey confirmed the MTA performance on resolving open AFRs lags behind the other properties:

	Percent of Total AFRs Not Resolved Within:	
Property	30 days	90 days
MTA	31%*	21%*
BART	30 - 40%	10%
WMATA	5%	<1%
MARTA	<5%	<1%

* As of January 12, 1995

AFRs should be resolved as quickly as practical. Until an AFR is resolved, Quality Assurance has no way of knowing if the process in question is yielding quality results.

Recommendation #13: Implement mechanisms into the AFR process to hasten resolution. Some possible approaches which may be considered are:

- Exit meeting commitment - Two properties surveyed use their audit exit meetings with the RE or contractor to ensure both sides understand the issues and agree on appropriate resolution steps. The audit report is not finalized until this discussion takes place.

- Notification of overdue AFRs to a higher level of MTA management - This approach has been implemented in conjunction with the change in reporting relationship of the Director of Quality from the Executive Vice President Technical Operations to the Executive Officer of Construction. This arrangement seems to be quite affective in dealing with overdue AFRs. The total number of AFRs open for more than 60 days has decreased from 45 to 23 in the past 2 months.

Submittals

Submittals is another process which can impact quality. Submittals are documents contractually provided to the MTA by the contractor. Submittals include shop and working drawings, product data, samples, certifications, operations and maintenance manuals, construction workplans, and other documentation. Submittals tell the owner how the contractor intends to perform work or verify the result (e.g., test results). The REs are to obtain a master list of required submittals and ensure they are provided by contractors in a timely fashion. Missing or insufficient submittals have been frequently noted in AFRs. In fact, during the period of 1991 to 1994, submittals have gone from the fifth most common type of discrepancy cited, to second. This trend is shown below:

Year	AFRs Written Due to Submittal Problems	Percent of Total AFRs Due To Submittal Problems
1991	1	7%
1992	5	11%
1993	9	10%
1994	14	18%

When submittals are missing or insufficient, the opportunity exists for quality problems. Construction procedures being used may be inadequate to ensure product quality. Lack of test results may result in substandard materials being used.

Recommendation #14: Review the submittal process to improve its effectiveness. Controls should be put into place to better ensure that adequate, timely submittals are provided. Submittals are the documentation used to verify that the contractual obligations for quality have been met. Therefore, it is critical that the MTA ensures that <u>all</u> submittals are received. The MTA has initiated a formal Work Process Improvement Program (WPI #58) to review the submittal process. Team meetings were held the week of March 27, 1995 to begin this program.

Specification Development

If processes or specifications are needed to ensure product quality, but do not yet exist, it is the responsibility of the Quality Assurance department to identify this need and put the appropriate process or specification in place. One example would be tunnel subsidence specifications. Inspectors can only measure and control a production process if they have a procedure or specification to guide them. In the case of tunnel subsidence, no such procedure existed. For the MRL - Segment 2 tunnel, this need has been identified and a procedure implemented. However, this procedure has not been implemented on MRL - Segment 3. Without such a specification, the determination to stop work becomes a "management decision", rather than a quality issue.

Recommendation #15: The MTA should implement a tunnel subsidence specification for all tunneling activities immediately. The MTA faces exposure with the public when guidelines for alleviating subsidence appear to be discretionary. Additionally, the MTA is exposed to greater risk of a harmful accident or costly repairs without clear-cut guidelines.

Stop Work Orders

Stop Work Orders inform the contractor to stop working on some or all of their work. Stop Work Orders are issued by the RE if continuing work would have a detrimental effect on the quality of the product or would violate an important contractual obligation. Safety personnel, inspectors, REs, and CM management can issue Stop Work Orders for safety reasons.

Until recently, no written procedure existed to provide the REs guidance on the conditions or process for generating a Stop Work Order. Issuing Stop Work Orders were left up to the discretion of the REs. With no specific guidelines outlining the conditions and circumstances under which a Stop Work Order should be issued, contractors and others may "debate" a Stop Work Order to attempt to change the RE's mind.

Recommendation #16: The MTA should document procedures outlining the conditions under which a Suspension of Work Notice can be written. The process for resuming work and contingencies for failure to comply should also be developed. A new Suspension of Work Notice procedure has been developed and was issued December 16, 1994 and revised on February 20, 1995. Included are the conditions under which work may be ordered stopped:

- Life threatening or unsafe conditions
- Danger to the general public
- Clearance form a utility company to proceed is required and has not been secured
- Work performed is not in accord with the contract documents
- Contractor is not in compliance with applicable laws or regulations.

However, we recommend the conditions and circumstances be more specifically identified. For example, "Work performed is not in accord with the contract documents" could be interpreted to include any nonconformance. Conditions need to be specific, or conflicts may arise over interpretation.

The process for resuming work or dealing with contractors who fail to comply has been documented. These procedures were tested on November 1st and 2nd when a contractor initially ignored a suspension of work notice. The procedures were followed and ultimately lead to the successful enforcement of the suspension of work notice.

Reviewing Processes and Procedures

Quality Assurance is responsible for reviewing processes and procedures to ensure they meet quality standards. Based on the survey, it appears Quality Assurance devotes insufficient time to be effective. MTA Quality Assurance devotes 15% of their time **reviewing** processes and procedures, other properties average 35%. This time is important to ensuring the processes and procedures that will be used by contractors meet the criteria of the overall quality system.

Section 6, paragraph 4.3 of the Quality Assurance Program Manual states: "The RCC Director of Quality or designee is responsible for the review and approval of written work plans, procedures, or instructions for compliance with RCC policies and procedures, the RCC Quality Program Manual, and all applicable contract documents."

The MTA relies heavily on the CM's REs and Quality Control department to review workplans, procedures, and instructions. REs review contractor submittals and as - built drawings. Quality Control reviews construction workplans, electrical and mechanical procedures, installation procedures, and test procedures. As a result, few documents are thoroughly reviewed by the MTA, even if they are ultimately responsible for approving them.

The delegation of review responsibility creates a potential problem since no one organization sees the big picture of how all elements work together to ensure the integrity of the entire quality system. The broad perspective is important to ensure consistent interpretation and application of quality processes.

Recommendation #17: The Quality Assurance department must take a greater role in reviewing and approving submittals and procedures. This may require adding more technically skilled personnel who can adequately perform this task. Identifying weaknesses early is critical since process deficiencies can result in quality problems later on when identification and correction is more difficult and costly. Sound process designs and specifications up front can alleviate quality problems later on. Also, if the processes or procedures are flawed, then ensuring adherence to them is meaningless. Focusing on the processes and procedures up front is critical.

Monitoring Processes and Procedures

Once the Quality Assurance organization is satisfied that the relevant processes and procedures are in place, QA periodically monitors them to ensure they are being followed as intended. Monitoring can be periodic formal audits of multiple processes and procedures or more informal surveillances of specific ones. The QA organization determines the amount of audits and surveillances to perform to give them the assurance they seek. Audits provide more thorough evaluations, but typically cannot be performed frequently due to the greater resources required. Surveillance are narrow in scope, usually focused on a single procedure or process, but give frequent assurances that procedures are being followed. A formal audit typically will take an auditor weeks to complete, while a surveillance of one process can be done in days or hours.

As shown from the survey, MTA Quality Assurance spends a greater percentage of time **monitoring** processes and procedures in the field (85% vs. 55%). This is due in part to the greater time spent on each audit by the MTA. The MTA spends 4 weeks per audit, compared to 2 weeks or less for the properties surveyed.

The primary reason MTA audits take longer is due to the scope of processes and activities covered by their audits.

Quality Assurance audits typically begin by reviewing the QC process. This is the focal point for a formal audit. Most properties also audit other quality related processes such as

construction workplans, submittals, change order processing, as-built drawings, and document control. However, the MTA also performs extensive in-process inspections to, in effect, double check the work of the QC inspectors. Other properties concentrate on verifying that the inspectors performed their tasks as described in the QC procedures, not actually checking the work themselves. Additionally, the MTA also audits cost and schedule processes, which others do not. These include payment processing, claim processing and avoidance, and scheduling.

The audit resources and scope of each property is compared below:

		Audit Scope			
Property	Audit Time (weeks)	Quality Control Processes	Quality Related Processes	In-process Verification	Cost & Schedule Processes
MTA	4	Yes	Yes	Yes	Yes
BART	2	Yes	Yes	Yes	No
WMATA	1/2	Yes	No	No*	No
MARTA	2	Yes	Yes	Yes	No

* Will do on selected basis only

The additional breadth of the MTA quality assurance audits does not necessarily provide any greater assurance of product quality. In-process verification essentially double checks the inspectors' work. Cost and schedule processes are important, but are usually monitored by a more financially oriented group such as internal audit. At BART, for example, these areas are audited by their Finance and Accounting group. At MARTA cost and schedule processes are audited by a corporate audit group.

Quality Assurance management has elected to rely on these broader audits in lieu of more frequent surveillances. In fact, the number of surveillances has dramatically decreased each year as construction activity on MRL - Segment 2 has increased. More audits were performed as shown but fewer resources remained to conduct surveillances. This decreasing trend in number of surveillances is shown below:

Year	Total # of Surveillances Performed	Total # of Audits Performed
1992	42	22
1993	35	39
1994	13	43

Compared to other properties surveyed, the MTA performs far fewer surveillances:

Annual # of Facilities and Tunnel Audits and Surveillances (per contract)

Property	RE Audits	Contractor Audits	Surveillances
MTA	1	1	1
BART	1	1	52
WMATA	None	1	52
MARTA	1	1	52

Other properties use frequent surveillances of critical processes to provide them satisfaction that the processes are being executed properly. Due to the infrequent presence of QA auditors on site, the MTA does not get such frequent assurances.

Other properties also streamline the audit process by using standardized audit checklists. These checklists are then tailored to the specific audit being conducted. Standardized checklists ensure consistency from audit to audit and between different contractors, CMs and REs. To effectively use a standardized checklist, nominal resources are required to maintain and update it. The MTA used a standardized checklist in the past, but discontinued its use due to staffing constraints.

Recommendation #18: The scope of formal audits should be refocused thereby providing more time to audit product quality. At a minimum, the responsibility for auditing cost and scheduling processes should be transferred to another department, such as Internal Audit. Shifting responsibility for cost and schedule auditing allows Quality Assurance to focus on those processes critical to product quality. Additionally, internal or financial audit groups tend to have the specific skills necessary to perform an efficient, thorough audit of cost and schedule areas. Resulting time saving from **monitoring** should be devoted towards **reviewing** quality processes and procedures and performing more frequent surveillances.

Recommendation #19: The frequency of surveillances should be significantly increased. Quality Assurance should target to visit each construction site weekly. This additional visibility will allow QA to better understand how critical processes are actually being performed in the field and to identify quality issues more quickly. Quality Assurance has already begun to increase their surveillance activity, performing 16 this year (as of March 25th), which is approximately 2.5 surveillances per contract per year.

Recommendation #20: The standardized audit checklist should be reinstated for audits of processes, such as Quality Control. The standard checklist is tailored to meet the needs of the specific audit being conducted. Starting with a standard checklists ensures issues are not overlooked and audits are consistent from auditor to auditor. In the long term, a standard checklist also saves time in preparing for an audit.

7.0 Quality Control Findings and Recommendations

Quality Control (QC) is carried out by those responsible for production activities that manage the work, meet the product goals, and achieve the quality requirements. 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 and the process of documenting such actions.

As described in Section 2.0, Issues of the Function, the management of Quality Control for the MRL - Segment 2 has changed several times. Five distinct approaches have been used:

1. Quality Control inspectors provided by and managed by contractors
2. Quality Control inspectors provided by the CM and managed exclusively by CM Resident Engineering
3. Quality Control inspectors provided by the CM and managed primarily by CM Resident Engineering, and secondarily by CM Quality Control
4. Quality Control inspectors provided by the CM and managed primarily by CM Quality Control, and secondarily by CM Resident Engineering
5. Quality Control inspectors provided by the CM and managed primarily by MTA seconded Quality Control management, and secondarily by CM Resident Engineering

The first approach was agreed to be ineffective. Contractors did not fully understand or carry out their responsibilities to the MTA.

The second approach was an improvement, but some undesirable consequences resulted. REs had total authority over how inspectors spent their time. While controlling resources is beneficial from a production standpoint, in the absence of proper controls REs could, theoretically, suppress information. Anecdotal evidence exists that this did occur on occasion,

i.e., that nonconformance reports were never submitted and inspection reports edited in the interest of maintaining the production schedule.

Adding the indirect reporting responsibility to Quality Control management described in Approach 3 was viewed as little improvement over Approach 2.

Approach 5 is currently in place. The direct reporting of inspectors into the MTA seconded Quality Control department with indirect reporting to Resident Engineering seems to be effective. The Quality Control group believes sufficient checks and balances are now in place to prevent compromising situations from occurring in the future.

REs use inspectors as a resource to assist in other, non-quality areas as needed. An informal survey of inspectors conducted internally showed that greater than one third of inspectors' time was being devoted to non-quality activities such as third party coordination, coordination of construction activities, and progress documentation. Fluor Daniel report PMO Task 10/10/004 cited this as a concern on the Green Line as well.

Geotechnical and Surveying personnel also report to Quality Control. While Geotechnical performs measurements as part of their normal activities, they do not directly measure the quality of production output. Also, Geotechnical and Surveying are highly technical, specialized positions which place a significant burden on Quality Control management. Up to 70% of the Quality Control Manager's time is spent managing these functions. This distracts the group from its primary focus on quality control.

Recommendation #21: As stated in ***Recommendation #3***, the MTA should not assume responsibility for Quality Control. The Quality Control Manager should report directly to the CM's Construction Manager, and indirectly to the MTA's Director of Quality. We do, however, concur with the recent changes in reporting relationship of inspectors within the CM. The direct reportingof insectors to the Quality Control Manager (through the Lead Inspectors and Project Chief Inspectors) provides sufficient independence of the inspection function. The indirect reporting to Resident Engineers allows the REs to provide inspectors daily direction necessary to manage production effectively. See ***Recommendation # 5*** for details of these reporting relationships.

Recommendation #22: The issue of how inspectors spend their time needs to be addressed. Inspectors should spend the majority of their time on quality related issues. The Quality

Control Manager should work with the CM's Segment 2 Manager to develop possible alternatives. Dedicated staffing, such as a field engineer or cost and schedule engineer may need to be considered.

***Recommendation* #23:** A Technical Services group should be formed within the CM to manage the production support groups such as Geotechnical and Surveying. Additionally, Environmental and Utilities could be part of this group. Removing non-QC related activities from the QC organization allows greater focus and attention on quality issues. Test and Start-Up should remain a QC function.

CHAPTER XV
Volume B

PUBLIC AFFAIRS

1.0 Nature of the Function

The MTA, through their External Relations Division Public Affairs staff, establishes public affairs policy and coordinates community activities designed to educate and respond to community concerns about rail construction. As such, Public Affairs serves as a liason between the MTA and the public. Additionally, Public Affairs involvement can include specifying work constraints for particular contractors, such as restricted work hours during rush-hour traffic periods or noise suppression techniques to accommodate a hotel or nearby hospital.

The overall responsibility for performance of the Public Affairs function resides with the MTA and is primarily directed by the Deputy Director, Public Affairs and Public Affairs Managers. Additionally, Public Affairs activities within the MTA are often augmented by personnel from the CM who provide technical information about construction activities and coordination with Resident Engineers.

The Public Affairs function is designed to meet the MTA's objectives which include the following:

1. Establish and maintain an active and consistent MTA presence to foster continued public acceptance for rail projects
2. Provide adequate information to residents, business owners and commuters about construction projects and their resulting impacts
3. Minimize the disruptive impacts resulting from construction

2.0 Issues of the Function

An effective Public Affairs function is an integral part of a successful, well-managed rail construction project. When Public Affairs complements the entire construction effort, the MTA can achieve a positive image within Los Angeles communities, as well as reduce total project costs impacted by public interference or legal claims. A poorly functioning Public Affairs department can have serious impacts on the MTA's image, and can even affect the MTA's

ability to effectively complete a project. Community resistance and legal actions may impede the progress of rail construction activities or future rail plans.

Achieving a sound Public Affairs function requires an effective MTA presence in the community and excellence demands that MTA Public Affairs representatives possess a thorough understanding of the construction activities impacting local business and residents. Public Affairs Officers rely on the MTA project team members for complete information on planned and existing construction operations. Proactive information campaigns through local meetings and printed news materials keep the community informed of pending construction activity and allow individuals to plan in advance of disruptions. An effective MTA presence in the field also requires that an adequate number of Public Affairs Officers and Public Affairs Managers are assigned to cover an area of project construction.

Another requirement for a quality Public Affairs presence is the willingness and ability to act on the concerns of citizens. When the MTA demonstrates flexibility to accommodate area concerns such as noise, vibration, dust, etc., the community will more easily accommodate the remaining construction activities. Of course, the MTA must balance this requirement with their custodial duty to control costs. This requires a close association among the Public Affairs function and project team members of other functions such as Engineering and Construction Management.

Achieving the maximum benefit from an effective Public Affairs policy requires that the Public Affairs function itself, be tightly woven into the project team throughout construction activities. This is essential to ensure that prudent actions are taken to minimize the negative impacts of construction activities.

Public Affairs best serves the MTA when the message conveyed to citizens, the media and elected officials is timely, up-to-date, relevant and consistent. Responses that are incomplete, inconsistent or nonexistent severely undermine the good faith the MTA has cultivated in communities.

The findings, implications and recommendations highlighted in the sections to follow are focused on what we believe to be the principle Public Affairs issues facing the MTA for rail construction projects. These issues can be summarized as follows:

1. Adequate Resources: MTA construction activities encompass a wide geographical area of the Los Angeles basin. Deploying sufficient Public Affairs resources is critical to achieving and maintaining a positive image for the MTA
2. Consistency of Presence: Public Affairs officers are far more effective when they possess familiarity with a given construction area, its residents and its specific issues
3. Organizational Support: The Public Affairs function requires close communication from a variety of disciplines within the MTA. Efforts supported by the project team as well as by the entire MTA organization help the MTA establish a consistent, positive image in the community

3.0 Findings Regarding the Function

During major construction efforts, the CM's Community Relations staff is familiar with augmenting the efforts of the MTA's Public Affairs Officers. Specifically, the CM Community Relations department supports the MTA staff by providing technical information about construction status, assisting in the coordination of community activities and ensuring that the Resident Engineer is working with his contractor to implement MTA Public Affairs policy.

The following summarizes the major duties performed by the CM organization, in priority order, as they relate to Public Affairs:

1. Provide direct assistance to the MTA in coordinating and performing public affairs activities
2. Direct all media inquiries or requests for project-related information to the MTA Public Affairs staff for appropriate response
3. Make provisions to accommodate MTA-approved project site visits through the Resident Engineer, with support from the CM Community Relations group
4. Place CM Community Relations staff in MTA-established information sites
5. Work with REs to address community complaints and develop impact mitigation

The MTA Public Affairs function is a part of the External Affairs organization, which reports directly to the MTA Chief Administrative Officer. The MTA Public Affairs function is primarily responsible for developing Pubic Affairs policies, maintaining a presence in the field and directing the activities of the CM Community Relations staff.

The following summarizes the major duties being performed by the MTA organization, in priority order, as they relate to Public Affairs:

1. Perform outreach activities to minimize the impacts of project construction to the community. Coordination and implementation of community participation projects such as the construction site art program
2. Coordination of community meetings on a regular basis to inform the public of construction activities and impacts
3. Planning of the production and location of project information exhibits and sites
4. Establishment and assistance with the staffing of information offices located along the rail segment
5. Production and distribution of construction notices
6. Establishment and maintenance of site specific and area wide mailing lists

Prior to 1993, Public Affairs was organized within the RCC's Construction. The Public Affairs Director reported to the Vice President of Construction and managed a total of four Public Affairs Managers and ten Public Affairs Officers. On Segment 2, six to eight Public Affairs Officers were assigned throughout the Wilshire, Vermont and Hollywood corridors, balancing their time between Public Affairs site offices, Resident Engineer field offices and downtown.

In October, 1993, the newly-formed MTA authorized a fifty-percent reduction in public affairs forces. To achieve this reduction, a severance package was implemented which ultimately enticed eight of the ten public affairs officers to resign instead of the five planned. All but two Public Affairs Officers supporting the Red Line - Segment 2 resigned. To meet staffing needs, three individuals from Parsons-Dillingham were seconded while vacant positions could be re-filled. A total of eight additional Public Affairs Officers have been hired, the last acquired in January, 1995, sixteen months after the initial severance offering. Currently, one Public Affairs, Manager position is vacant.

Shortly after the staff reductions mentioned earlier, the Public Affairs organization was transferred from the Construction Division to the MTA External Affairs Department under the MTA Deputy CEO, where it currently resides. The MTA External Affairs Department also contains the Marketing, Media, A-R-T Program and Inter-Governmental Relations functions (as shown in Exhibit 1).

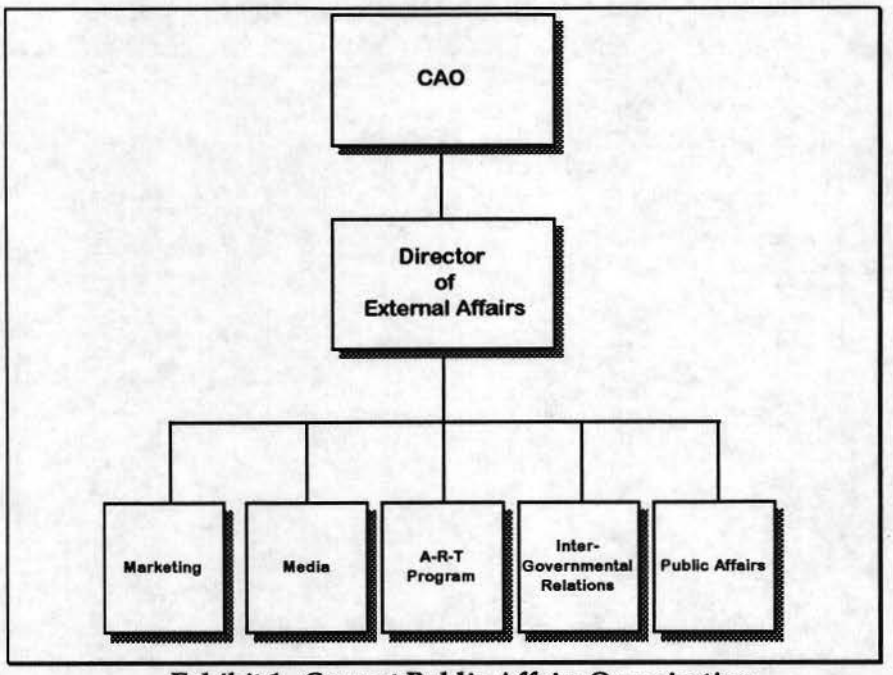


Exhibit 1. Current Public Affairs Organization

It was noted during our interviews with Public Affairs personnel that after transferring the Public Affairs function from the Construction Division, some Public Affairs Officers have encountered difficulty gaining access to project meetings and in obtaining information from project team members.

The Public Affairs function also serves in an internal communication role, in an effort to foster closer working relationships among employees. Prior to the formation of the MTA, several internal newsletters and awards were used to recognized the achievements of LACTC and RTD employees. Examples included the LACTC/RCC Employee of the Month Hall of Fame and the TEAMMETRO and Headway newsletters. After the merger, the MTA determined that these communications were too rail- and RCC-oriented and did not fairly represent all aspects of the MTA organization. Subsequently, the MTA discontinued the majority of such newsletters and awards.

During the major subsidence occurrence on Hollywood Boulevard, MTA executives, staff and consultants faced a barrage of inquiries for information from the community, the media and elected officials. MTA Board members, elected officials, the media and concerned citizens often received different information depending on the MTA or CM staff member they spoke with. This clearly added to the confusion, concern and frustration raised by the subsidence incident, and reflected poorly on the MTA's ability to manage a challenging situation.

In November, 1994, Public Affairs created a Daily Metro Rail Tunneling Status Report to ensure consistency of information regarding tunnel progress for internal and external parties. The report lists the tunnel progress (linear feet) achieved for that day and the past week, the maximum settlement experienced ahead and behind the tunnel face, the current location of the tunnel boring machine (i.e., near which intersection), the status of grouting operations and expected tunneling activities for the following day. The information is reviewed and approved by the Resident Engineer and MTA Project Manager. All members of External Affairs receive a copy of the Daily Metro Tunneling Status Report and refer to it when responding to inquiries from the community, media or elected officials.

4.0 Implications of Our Findings

Staff reductions, reassignments and a lack of access to information have all negatively impacted the ability of the Public Affairs function to support construction activities. The MTA failed to adequately consider the impacts of reducing Public Affairs resources at a time of accelerating construction activity. As a result of significant Public Affairs staff turnover, the Red Line Segment 2 project team could not provide the active, consistent community outreach required at a crucial time before peak construction activity began along Vermont Avenue and Hollywood Boulevard.

Within the External Affairs organization, the Public Affairs function did not succeed in influencing media and public reactions to the Hollywood tunnel subsidence episode. What has been experienced regularly throughout the world during tunnel construction has, in the media frenzy of Los Angeles, threatened the very existence of the rail program. The local news press has routinely portrayed the MTA and its consultants in a negative light, and the Public Affairs function has not proactively asserted the "good news" to portray MTA rail construction activities in a more favorable light.

Because certain Public Affairs personnel have expressed difficulties in attending meetings with project team members of other functions, project team personnel may not view the work of Public Affairs as necessary or relevant to constructing a rail system. A perception may exist that Public Affairs personnel lack credibility as it relates to construction issues. The transfer of the Public Affairs function from the Construction Division has exacerbated this problem. This has hampered efforts to proactively manage Public Affairs and may explain why the MTA has at

times been in the position of seeking "forgiveness" instead of seeking "permission" from effected individual and businesses.

5.0 Recommendations for this Function

We believe the current structure of assignments between the MTA and the CM is the preferred structure. Therefore, we recommend that the MTA not assume any additional tasks from the CM related to Public Affairs. The MTA should continue to oversee and perform the primary activities of Community Relations while augmenting its efforts with resources from the CM.

By retaining the current structure, we believe the MTA will obtain the following benefits:

1. Information Coordination: A fully integrated Public Affairs and External Affairs organization will allow the MTA to develop Public Affairs policies that are consistent with external communications, and ensure that the MTA Chief Executive Officer is fully informed of rail construction issues
2. Consistent Presence: Project-assigned Public Affairs Managers and Officers will maintain dedication to the project team and continuity within the specific communities impacted by construction activities
3. Community Involvement: By maintaining a prominent role in community interaction, the MTA avoids becoming a "faceless entity" delegating its community responsibility to hired consultants
4. Staffing Flexibility: By requiring the CM to provide Community Relations support, the MTA will experience less staff limitations as community demands increase (particularly during peak construction) compared to if the MTA were to take this function completely in-house. A larger and more visible public presence may lead to a better anticipation and/or acceptance of disruptions during construction
5. Better Coordination: A CM presence in Community Relations will allow a more effective division of responsibilities. The CM resource can offer added technical support to the MTA Community Relations effort by remaining closer to the Resident Engineers, Contractors and the CM's management

We also recommend that the MTA retain the current organizational reporting relationships as it relates to the Public Affairs function. By retaining the Public Affairs function within the External Affairs organization the MTA Chief Executive Officer will have the fullest communications channels available to him as he represents the MTA to the Public. However, in

recognition of the functions importance to construction activities, we recommend that the office of the CEO implement a new approach to providing Public Affairs services to the Construction Division.

We recommend that the Public Affairs group form a "contract" or "letter of agreement" defining that nature of the relationship between Public Affairs and other divisions of the MTA, including the Construction Division. In acquiring this service the Construction Division will want to define or describe the following:

- Services to be provided, including the level of quality and responsiveness
- Length of service - typically one year with renewal to coincide with the annual budget process
- Cost of service
- Skills and experience required of the specific service provider
- Right to approve and accept specific individuals who will provide the service selected based on the above criteria
- Cancellation Policy
- Options to Procure additional services during the contract period
- Specific performance measures to be used to measure the level of satisfaction with services provided
- Right to evaluate Public Affairs personnel assigned to Construction and significantly influence their annual review

In its agreement with the Construction Division, the Public Affairs function should also specify the following :

- Services to be provided, including the level of quality and responsiveness
- Length of service - typically one year with renewal to coincide with the annual budget process
- Price of service
- Skills and experience required of the specific service provider
- Cancellation Policy
- Options to provide additional services during the contract period
- Support Requirements to be provided by the internal customer (e.g. office space, secretarial support, telephone and fax service)

- Specific feed back based on agreed upon performance measures at agreed upon time intervals
- Opportunity to earn "bonus" dollars based on meeting and/or exceeding the internal customer's expectations as defined by agreed upon performance measures

The "contract" should be signed by both parties and subsequent disputes should be resolved by the CEO or COO, as appropriate. This approach has been used with success by other authorities and companies in other industries and offers a unique way to foster a spirit of cooperation and teamwork between internal service providers and customers.

To further enhance the consistency and effectiveness of communication channels, the Daily Metro Rail Tunneling Status Report concept should be extended to all major construction work, though the frequency of the Report should be modified to the degree of construction activity in place. This recommendation will help to ensure that information is consistent and up to date and is easily accessible to meet requests from the public.

XVI. Risk Management

Chapter XVI
Volume B

RISK MANAGEMENT

1.0 Nature of the Function

Risk Management is an element of every type of human endeavor. Simply stated in business terms, it is the method in which an entity chooses to manage the risks it has of financial loss, and how it chooses to pay for losses as they occur. Examples of typical losses are employee injuries, vehicle damage, bodily injury to the public, products liability, professional liability for doctors, lawyers, architects, engineers and environmental/pollution liability.

When a Risk Management program is integrated effectively into large entities it is usually directed by an individual designated as the Risk Manager, or related title, with a risk management philosophy communicated to all levels of operations.

1.1 The Risk Management Process

Risk management is a continuous four step process:

1. The first step of the Risk Management process is to identify an entity's potential exposures to financial loss. Exposure is based on both the frequency and financial severity of an event. This step is often referred to as the risk assessment step of the process, i.e., what could happen as a result of our business activities, e.g. injury to employees, visitors, or innocent bystanders; how could our property or the property of others become damaged; what would cause our operations to cease; what could we do to cause the operations of another to cease; etc.

2. The second step of the risk management process is to consider the various alternatives to managing these exposures commonly called the selection of the treatment method.

There are four basic options to managing risk/exposures:

a. The first option is the transfer of risk to another entity. The purchase of insurance is the most common form of risk transfer. For a known cost, i.e., premium, an insurance company will agree to pay for predetermined types of losses, up to the policy limits. Losses exceeding policy limits are assumed or self-insured, see below. In addition to an insurance policy, insurers often offer claims handling services, safety and loss control services, data systems, etc., all as part of that transfer of risk option. Another transfer of risk option is to have another party accept risk through a contractual arrangement.

b. The second management option is to assume the potential risk of loss, either in part, e.g. a deductible, or in total, e.g. self-insure. Most individuals have a deductible on their automobile. This creates a risk sharing arrangement between the insured and the insurer which often (a) reduces costs (b) increases the amount of coverage, and (c) strengthens insurer-insured relationships.

c. The third management option is to reduce the potential risk of loss. One example might be to reduce the scope of a project. Another might be to improve the quality of a product or process. A third possibility is to implement stronger safety standards. The alternatives are based on the types of operations, who is in charge, what goals and objectives are trying to be achieved, etc.

d. The fourth management option is the elimination of risk. This step is usually considered if (a) the probability of loss is high, (b) the severity of loss is extreme, (c) risk transfer and/or risk reductions are impractical, and/or (d) it is financially unaffordable.

3. The third step of the risk management process is to choose the method, or methods, of managing the risks which have been identified. Most often, for large complex entities, two or more methods of treatment are chosen. It is not unusual to transfer some risk, assume part or all of others and reduce or eliminate certain elements of risks on a day in, day out decision making basis.

4. The fourth step of the risk management process is implementation/management of the courses of action chosen by management. This step requires proper professional management. The keys to this step are effective communication and attention to detail.

An integral part of this process is the development of a comprehensive and coherent Catastrophe Management Plan. A Catastrophe Management Plan is a detailed plan which is implemented at the time of a catastrophe, e.g. earthquake, flood, etc. The plan describes everyone's roles and responsibilities as to how to perform critical tasks such as talking to the media, coordinating medical services, managing the crews on site, notifying emergency personnel and handling claims. Two of its primary purposes are to minimize losses to injured parties and minimize financial loss for the entity. Such plans require an extensive commitment of time and energy to (1) ensure it is properly constructed and (2) that it is properly rehearsed so that (3) they can be properly implemented. Many public and private entities have postponed this exercise only to learn later how much more costly it was to not have a plan.

Often times, the Risk Management process is a misunderstood element of business. It is a process which is literally interwoven throughout all aspects of business. Therefore, risk managers must be proactive in their efforts to educate their co-workers as to why a particular program is important to the entity's goals and objectives. The Risk Management Department should be able to explain why the process is important to the people to whom they call upon for assistance to ensure the risk management process is successful.

The risk management process, although simple in concept, requires extreme attention to detail, including judgments about the type, size and probability of loss. Large entities, with complex exposures to loss, should seek as much input from qualified insurance and risk management professionals as is feasible. Risk Management individuals are a necessary part of developing an effective insurance and risk management plan for any entity.

1.2 Risk Management Personnel

As entities grow larger and/or more complex they recognize the need to employ one or more full time risk management personnel to manage the details of the risk management process. The roles and responsibilities of risk management personnel are often evolutionary, based upon the growing complexity of the operations, insurance programs, etc. The risk management personnel

roles must be developed sufficiently enough to allow them to effectively support the entity's goals & objectives. They should be allowed to establish communications with every facet of the operation and they should be evaluated to ensure they perform. Because risk management is a continuous and evolutionary process, it is important to asses an entity's risk management effectiveness at least on an annual basis.

1.3 MTA Organization

The MTA is an evolutionary organization, which is extremely large and complex. One of its evolutionary elements was the bringing together of two previously independent risk management units under one common leader. However, for all practical purposes, the two departments (Construction Risk Management and Operations Risk Management) continue to operate independently of one another. The Construction Risk Management Department, through the Administration Division, solely supports the Construction Division. The Operations Risk Management Department, also through the Administration Division, supports the risk management needs of MTA's operations. Both departments report to the CFO located in the Administration Division.

From a practical and best practices viewpoint, the current MTA Risk Management structure appears to meet the basic functional risk management needs of the MTA. The basis of this opinion is predicated upon the two distinctively different types of exposures, i.e., construction vs. operations, and the programs currently in place to support them.

1.4 MTA Risk Management Process

Exhibit 1 is provided as a partial identification of the MTA's potential exposures to loss. This Risk assessment matrix identifies some of the exposures to loss and their frequency and severity of loss. The key issues in the matrix are that on the operations side, the MTA has 100% direct responsibility for the operating exposures. On the construction side, the vast majority of the exposures are created by contractors. Although the MTA has influence over the daily operations, it does not have direct influence over the numerous contractors and their complex activities.

RISK ASSESSMENT CHART
(Partial)

MTA

Organizational Attributes	**Operations**	**Construction**
Type of Operations	Bus Rail	Construction
Primary Operating Sites	Surface	Underground
# of Oper. Sites	High	Low
Vehicles	High	Low
Safety Management	High	Medium
Loss Generators	MTA	Contractors
Work Force Attributes		
Workers	MTA	Many Employers
Architects/Engineers	Low	High
Contractors	Low	High
Type of Loss		
⇒ Severity	Low	High
⇒ Frequency	High	Low

Exhibit 1

From the MTA's risk management perspective, operation's exposures are of a high frequency/low severity nature. All are created by MTA employees over whom the MTA has direct management, safety and financial control. The construction unit has, except for workers' compensation losses, low frequency, high severity types of losses that are primarily caused by contractor's employees. The MTA has some influence but lacks direct control over these individuals.

It is a fundamental principle of risk management to assume/self-insure high frequency and low severity claims upon which you can implement systems which can influence the financial outcome, e.g. operational exposures. The contrary is equally true, i.e., an entity should purchase insurance for those exposures which are low frequency and high severity and/or those exposures where they have little or no direct control and/or responsibility, e.g. construction exposures.

After performing the risk assessment process, the MTA's Risk Management departments analyzed the options available to the MTA, e.g. transfer, assumption, reduction and/or elimination of risk. The MTA selected risk transfer (insurance) as its management alternative for construction and assumption of risk (self-insurance) for operations. The day to day activities of the Risk Management departments are to ensure implementation and management are achieved.

It must be remembered that risk management is a continuous process. In a large entity such as the MTA there are new issues every day for which the risk management process must be applied. At times, changes in business conditions may necessitate reversing previous risk management decisions. This is a critical point to remember. Failure to do so may create unnecessary exposure to financial loss. Effective Risk Managers recognize the evolutionary changes of business and continuously apply the risk management process in their daily responsibilities.

As part of our engagement, we were tasked to perform a general review of the following three risk management issues:

1. Management of Construction Insurance Reserves [Section 2.0]
2. Professional Liability Insurance (Master Project Errors and Omissions) [Section 3.0]
3. Construction Risk Management [Section 4.0]

2.0 Insurance Reserves

2.1 Findings

Workers' Compensation: The MTA Construction Division carries a Worker's Compensation policy with Argonaut Insurance Company (Argonaut). Coverage is purchased through a guaranteed cost program with no deductible. Argonaut collects a standard premium from MTA and handles all claims.

The policy provides for a partial refund of the standard premium paid in the event of favorable loss experience, i.e. actual claims and their costs are lower than expected. In no event will the MTA be liable for payments in excess of its standard premium regardless of its actual loss experience. This calculation is performed annually by taking incurred losses as of a certain date, applying a loss conversion factor (to account for loss adjustment expenses), adding in a provision for the insurer's expenses and subtracting this total from the standard premium. If loss experience is favorable, MTA will receive a refund (known as dividend) of some of the premium that had been paid to the insurer. In effect, the MTA pays for its own claims, loss adjustment expenses and a provision for the insurer's expenses with a guaranteed maximum equal to the standard premium.

By nature, the aggregate cost (losses) of workers compensation claims for a given accident period develop upward over time. Therefore, it is likely that subsequent evaluations will include incurred losses that are more mature (generally higher) than prior evaluations. Because the ultimate cost of a given claim may exceed early estimates it is likely that the MTA will return a portion of the previously received dividend to the insurer.

General Liability: Argonaut is also the MTA's general liability insurance carrier. General liability insurance is provided on a guaranteed cost basis, using a deductible, whereby MTA is responsible for the first $500,000 of claim cost per occurrence. Argonaut pays all claims and then bills the MTA for the deductible amount.

Others: Most of the other construction unit exposures involve infrequent but potentially catastrophic losses, e.g. professional liability and pollution. The risks associated with these exposures are dealt with as they occur. It is during these events that a Catastrophe Management Plan becomes an invaluable tool for minimizing the impact of the event. The insurance program providing coverage for these exposures is structured similar to that of general liability. Fortunately, few if any claims are expected. However, as claims arise, reserves should be handled in the same manner as described for workers' compensation and general liability.

2.2 Management of Insurance Reserves

Insurance claim reserves represent the financial recognition of potential costs generated by known claims and those yet unknown claims expected to be reported. The latter type of claim is referred to as incurred but not reported (IBNR). Because the MTA must pay a deductible portion for all claims other than Worker's Compensation, a potential liability exists in the form of any incurred but unreported claim.

Establishing accurate reserves allows management to ensure that necessary financial steps are taken to appropriately account for and fund insurance reserves. In many instances, given the difficulty of estimating IBNR amounts, the services of an actuary are obtained. (The MTA's Construction Risk Management does not use an actuary, but the Operations Risk Management does).

2.3 General Implications

For general liability claims, the MTA should carry a reserve for its portion of the liability for any unpaid or IBNR claims. Additionally, its insurance reserves should adequately provide for the possible return of Worker's Compensation dividends. We understand that the MTA's Construction Risk Management Group estimates a reserve based on expected losses after reviewing historical experience. This reserve fund is then approved by MTA's Board. If the fund approaches exhaustion, or appears to be inadequate, the Board is asked to approve a higher amount. Currently, no actuarial analysis is performed to estimate the amount of MTA's expected losses.

For these coverages which involve high frequency of loss, compared with coverage such as professional liability, actuarial methods are available which can estimate expected losses (and hence, MTA's expected liability) with a fair degree of accuracy.

For the other coverages, such as Errors & Omissions and Pollution Liability, estimating expected ultimate losses is very difficult. This is because specific losses are not readily identified, the expected frequency is usually very low and the potential severity is high. Actuarial methods are usually not as helpful for these types of coverages.

2.4 Recommendations

We recommend that an actuarial confirmation be made of the MTA's insurance claim reserve for the construction program's general and workers compensation liabilities. Most companies and governmental entities that self-insure significant exposures, e.g. workers compensation and general liability, obtain actuarial reviews to assist them in determining a reasonable reserve. Although the construction program is an insured program, it does incur up to $500,000 for each loss occurrence for general liability events. While the workers' compensation program is a loss sensitive program, there is a potential that previously received dividends will have to be refunded. Obtaining an actuarial valuation will allow management to review the adequacy of its established reserves and determine whether its current funding is sufficient.

3.0 Professional Liability Insurance Program (Master Project Errors And Omissions)

3.1 Objectives of Professional Liability Insurance Program (E&O)

The MTA in cooperation with the EMC established a "Master Project Errors and Omissions Professional Liability Insurance Program" covering all design and consulting engineers, construction managers and subconsultants. The program was expected to accomplish the following goals:

- Offer significant cost reduction versus the traditional insurance approach in terms of premiums and administrative cost for small claims;
- Facilitate increased participation by architectural and engineering firms of all sizes, thus affording more opportunities for Disadvantaged Business Enterprises;
- Serve as a vehicle to recover a portion of the investment income;
- Establish an "Alternative Dispute Resolution" process to reduce litigation time and expense;
- Provide a stable program structure that is non-cancelable and isolated from insurance industry cycles;
- Provide insurance coverage for unlikely, but significant catastrophic events;
- Create a partnership among the MTA, the EMC, the CMs, the sub-contractors, and the professional liability insurance market.

Although the MTA is not the insured party under the program (the professional service providers and contractors are), it pays the costs for the program. There is a charge to the participants, based upon a pre-determined percentage of their contract price for purchasing coverage in the program. Overall, the Errors and Omissions Program is less expensive and less difficult to administer than typical approaches requiring the individual contracting parties to acquire coverage.

The MTA, MTG and the EMC all participate in the administration of this program. The EMC is responsible for informing the contractors about the program and getting the participants signed up and/or confirming they already have coverage. They are then to inform the MTG who in turn administers the program elements. The EMC is also to notify the MTA Director of Contracts as to which contractors are part of the program and need to have the cost netted from their billing.

The Construction Risk Management staff have primary responsibility for ensuring the program works. Various individuals have critical administrative responsibilities.

3.2 Findings and Implications Regarding the Program

During the course of review several issues arose as to how effectively the program was being administered, or in some cases if it had even been initiated. For example, although coverage became effective on November 1, 1992, the Alternative Dispute Resolution (ADR) element of the Program is still not operational. ADR mandates the use of mediation and other similar activities to reduce litigation time and expense and is one of the program's key elements. This delay has created some confusion among the MTA and the covered partners.

It is critical, in light of the Hollywood Boulevard case, to resolve this issue. It would appear that there is the potential for increased claims because of unnecessary finger pointing being conducted between the parties.

In certain instances, participating contractors have not yet been charged for coverage because of the yet to be resolved ADR issue. For instance, the MTA was to assess the EMC an annual charge of $500,000 for coverage under the Master Project Errors and Omissions policy. Recently, it was discovered no assessment had been made even though the program had been in

existence for twenty-nine months. A $1,250,000 assessment was subsequently made to correct for the lack of previous assessments.

Because the MTA collects its "premiums" by netting them from contractor progress payments, it may experience difficulty in trying to collect past due assessments from contractors whose work has been completed and their contract closed out. In these instances, the MTA would have to find an alternative collection method to recoup any outstanding premiums.

During a recent meeting between the Construction Risk Management staff, contractors and the construction management personnel, it became clear that even at this date many of the contractors do not fully understand how the program may help them. Additionally, there was also some confusion as to whether or not all contractors were participants in the program.

The construction risk management staff and the Mass Transit Group (MTG) Program Claims Administrator stated no professional liability claims have been submitted as of March 27, 1995 (several small claims have been handled within the retention level, but no claims have been filed which are large enough to submit to the insurer). However, in a discussion about change orders, it was suggested that some change orders were actually professional liability errors and omissions claims which would be submitted at a later date.

Additionally, as coverage is currently scheduled to terminate on October 31, 1999 several key questions will need to be answered. How long is coverage intended to be purchased? What about claims which may occur after this date? Should coverage be extended, and if so, for how long? What basis is used to make this decision?

Overall, the Program is well conceived and should become very effective once all of the elements become operational, e.g. Alternative Dispute Resolution (ADR) and accurate billing of program costs to participating consultants/contractors.

3.3 Recommendations

Based upon our review, we have four recommendations. The first and most important of these is to communicate, or re-communicate how errors and omissions claims will be handled within the bigger "Catastrophe Management Plan". Communications should include detailed

procedures from A-Z, about all entities' duties and obligations. The Hollywood Boulevard incident should be a poignant reminder of the need to resolve the ADR issue and ensure the Catastrophe Management Plans are effective.

Secondly, a meeting should be arranged between the Construction Risk Management staff, the Executive Officer - Construction, the CM's and the Director of Contracts - Construction to clarify the identification and administration of professional errors and omissions claims. The discussion should specifically address the potential for change orders becoming claims, and how they should be handled.

Thirdly, information should be disseminated to all potentially affected parties as to the MTA's intention regarding the potential extension of coverage beyond October 31, 1999 and what, if any, impact it may have on the consultants/contractors.

Fourth, and last, we recommend a comprehensive summary of the status of this program be provided to the Executive Officer - Construction and the Board, stating the potential problems which could arise out of yet to be resolved issues, including the establishment of the Alternate Dispute Resolution function.

4.0 Construction Risk Management

4.1 Nature of the Function

In coordination with all other key individuals, both MTA staff and contracted personnel, the Construction risk management staff and its outsourced support personnel have the unique responsibility to develop, implement, manage and modify as necessary a risk management program that supports the goals and objectives of the MTA's Construction Division and Metro Rail Program. These efforts should be coordinated with those of the MTA Board, MTA senior management and specifically senior management of the Construction Division.

As described in the introduction of this chapter, to accomplish the foregoing objectives it is critical that the four basic steps of the risk management process be utilized:

- Conduct ongoing risk assessment/identification of all MTA Operations and MTA Construction related exposures to financial loss
- Conduct ongoing analysis as to the most efficient and effective (cost and operations) method of managing the assessed risks, e.g. transfer, retain, reduce, eliminate
- Recommend to designated personnel the most favorable methods of treatment for all identified exposures, with supporting documentation identifying pros and cons for each recommendation
- Implement and manage the chosen course of action and ensure continuously effective evaluations are conducted and communicated to designated personnel

These steps are critical to every successful Risk Management program. Much of the success or failure of the program is the Construction Risk Management staffs' ability or inability to be extremely effective communicators.

4.2 Issue of the Function

As in any review, several issues were raised that addressed various aspects of the Construction Risk Management department. Issues raised addressed organizational structure, program effectiveness, staffing, etc. Two of the key questions were: (1) Do the two Risk Management departments communicate with one another, and (2) are there benefits to have an individual designated as the MTA Risk Manager?

4.3 Findings Regarding the Function

The Construction Risk Management Department is staffed with only three to four people but it is supported by outsourced risk management personnel (i.e., the Mass Transit Group "MTG"). The MTG is a joint venture, created by contract with the MTA. It is staffed with seven employees, whose Project Director reports directly to the MTA Construction Risk Manager. The duties are spelled out within their contract, e.g. administration, oversight of safety, claims, information systems, marketing, education seminars, loss reports, etc. The relationship appears to be strong and greatly strengthened over the past year.

Additionally, the department is supported by insurance brokers and underwriters who are recognized as industry experts in the construction insurance and risk management field. The account service personnel have become very knowledgeable about the daily risk management needs of the MTA Construction operations.

The core structure to the Construction Risk Management program, i.e., general liability, workers' compensation, excess liability and builders risk insurance programs, are structured and administered as one would expect for projects of this nature. They are written in what is called an Owner Controlled Insurance Program (OCIP). The determination of retention levels and limits are, according to the Construction Risk Management staff, market driven, i.e., what's available at what cost.

Although it was learned that Catastrophe Plans (Emergency Response Plans) are in place, it was not discussed how the Construction Risk Management Staff and its outsourced claims administrators are integrated into the process, if at all. If they are not, they should be. They have specific expertise which, if utilized, would assist in minimizing the financial costs arising out of a catastrophic event.

There appears to be little or no effective communication between the Construction Risk Management and Operations Risk Management Departments. Additionally, numerous times throughout our review individuals suggested that the Construction Risk Management Department could improve its communication skills and willingness to provide requested information to Construction. As mentioned several other times in this report, communication is the most critical element in the overall effectiveness of a risk management program, and it is one of the major weaknesses of the MTA's Risk Management Department.

4.4 Findings and Implications Regarding the Process

On the surface, there does not appear to be much potential for savings by integrating the two risk management programs. Most large projects, as has been previously described, have uniquely developed programs, specifically stand-alone, owner controlled insurance programs (OCIP), similar to the MTA's current program. Whether or not the program itself can be improved is the responsibility of the Construction Risk Management staff and their brokers.

Based on the foregoing comment, the same conclusion might be reached regarding staffing. Consolidation of departments may or may not reduce staffing. If it did, it would be minimal. However, there may be additional resources to one or both departments because of individual skill sets, systems, etc. For example, the sharing of safety, insurance, financial, claims, resources and expertise should stimulate ideas regarding financing program costs, claims management, loss prevention, safety, etc. Further, it would facilitate the sharing of the rail knowledge from the Construction Risk Management staff to the Operations staff.

One of the "open spots" of communication between the two departments is when does a rail line transfer from construction coverage to operations coverage, e.g. Green Line. Although this is not expected to create any additional exposure to loss, it is a situation that need not exist.

Lastly, there is no apparent understanding by either Risk Management department as to whether or not reserves are merely noted on the books, or if they are partially or fully funded. Historically, they were fully funded and reported monthly, but currently this situation is unknown, which poses a risk to the MTA and a potential unfunded liability may exist.

4.5 Recommendations for this Function

A single individual should be appointed as the Director of Risk Management for the MTA. This individual should be responsible for developing a singular risk management philosophy, supported by one or more different programs. This individual would then be responsible for ensuring the programs are appropriate, i.e., financially and operationally efficient and effective. In addition, the duties would require the effective integration of current resources, and maximizing the utilization of personnel.

With the Director of Risk Management in place, we recommend that the Construction Risk Management Function be transferred from the Administration Unit to the Construction Division. Under the resulting organizational structure, the Director of Construction Risk Management services would have direct line reporting to the Executive Officer of Construction and dotted line reporting to the new Director of Risk Management in the Administration Division. This transfer will facilitate the close working relationship and open communication required to provide the Construction Division with effective risk management services. Additionally, locating this function within the Construction Division will enhance the MTA's

ability to improve its existing construction safety program. Maintaining dotted line reporting to the Director of Risk Management in the Administration Division will ensure proper coordination of organizational-wide risk management issues and policy matters.

We recommend that an independent comprehensive communications audit be conducted within the construction unit to evaluate the general understanding and effectiveness of the administration of its construction risk management programs. This audit will highlight aspects of the construction risk management program which may have been inconsistently communicated or are poorly understood.

We also recommend, for the purpose of minimizing catastrophe claim costs, that the appropriate construction risk management staff and their associates be active participants of all catastrophe management teams. Failure to utilize such a process, unnecessarily exposes the MTA to potential problems in community relations, claims administration and settlement, litigation issues, etc.

Lastly, we recommend a cost benefit analysis be conducted, prior to extending the current contract with the Mass Transit Group (MTG), to determine the feasibility of increasing direct staff versus out-sourcing (perhaps by absorbing the outsourced staff). The basis of this recommendations is to (1) identify the potential cost benefit of altering the process and (2) to develop a broader, stronger MTA risk management team.

Chapter XVII
Volume B

HUMAN RESOURCES

1.0 Nature of the Function

The MTA Human Resource (HR) Organization supports the rail construction program by recruiting and retaining skilled individuals to manage its rail construction efforts. This process entails the administration of employee benefits, establishment of personnel procedures and providing support to MTA divisions in meeting their HR needs. Human Resources is also responsible for developing and implementing a compensation structure to retain skilled employees and reward positive performances.

2.0 Human Resources Issues

The MTA Human Resource Function as it relates to the Construction Division must be organized to achieve the following objectives:

1. Attract, hire and retain adequately skilled personnel to facilitate rail construction activities,
2. Fill all required and authorized positions in a timely and cost effective manner,
3. Fill staffing vacancies in a timely and cost effective manner with a minimal impact to construction activities,
4. Determine employee compensation in an equitable manner to reward and encourage positive performance from MTA staff.

In addition, staffing levels authorized by MTA management should meet the realistic needs of the Construction Division.

The MTA Construction Division operates a highly leveraged management structure. To properly oversee rail construction activities from design through construction, Construction staff are highly leveraged. They work with wide spans of control, overseeing the efforts of several to many consultants employed by the EMC and CMS and tens of millions of U.S. dollars

of work. Therefore, the effectiveness of the Human Resources organization in recruiting and retaining required staff in a timely manner is critical to the success of the MTA Construction Division.

3.0 Overall Conclusions

a. **Current Construction Division staffing requirements:** The MTA urgently needs to increase the actual headcount by 50% to fill important vacancies, including the Construction Division Executive Officer now vacant for almost six months.

b. **Efficiency of the Human Resources function:** Important vacancies exist throughout the Construction Division. These vacancies have endured over a significant period of time. In addition, the hiring process is excessively long.

c. **Project Management Plans:** As of today, the authorized staffing level is lower than defined by staffing requirements developed for the currently approved Project Management Plan (PMP) for each rail construction project.

d. **History of denied staffing requirements:** There is evidence of constant and significant denial by MTA management, of staffing requirements identified by the Construction Division. In addition, there are instances of the MTA instructing the Division to reduce actual headcount. Those denials of staffing and staff reduction mandates were experienced by the Construction Division while construction workload was increasing towards peak activity.

e. **Quality of skills:** Today, we would rate the composite set of skills of the Construction Division as not outstanding. We are not in a position to be more specific since we believe that Construction Division's staff have and still suffer from the consequences of:

- Lack of leadership,
- Lack of support and trust,
- Critical staffing shortage

A fair evaluation of the actual skills of Division personnel would best be accomplished through a comparison of actual performance against clearly predefined objectives or tasks. This would only be possible after the three problems above have been resolved. Consequently, we will not cover this subject any further in this report.

Conclusions a-d. above are developed in the following sections.

4.0 Current Construction Division Staffing Requirements

Over the past several months, the MTA Human Resources function has mobilized recruiting efforts for the Construction division. A total of 61 positions are currently vacant and under recruitment. These positions include the consequences of the October 1994 agreement with the FTA to have the MTA directly assume responsibility for the safety and quality functions. As a result, the current Construction Division staffing requirements per the MTA are detailed in Exhibit 1:

		Position
• Executive Officer of Construction		1
• Other vacant positions, before the effect of the October 1994 transfer in to the MTA of additional functions		21
• Vacant positions resulting from the October 1994 transfer in to the MTA of three functions		39
• Safety	16	
• Quality Assurance	14	
• Quality Control	9	
Total current staffing requirements per the MTA		61

Exhibit 1

In addition to the 61 positions in active recruitment, we have identified another 10 positions that have been requested and are required by the Construction Division, but have received no attention within the MTA. Please refer to Appendix 2 for a list of these positions.

For proper implementation of the recommendations presented in this report, we estimate that the Construction division will require an additional 7 positions that are neither currently requested nor in recruitment. These 7 positions consist of additional resources for Contract Administration, Cost Estimating and Project Controls. Offsetting this requirement is our recommendation to transfer the quality control function back to the CMs. If approved, as discussed in Chapter XIV of Volume B, the Division would not need to fill the 9 vacant positions related to this function.

In total, we believe the MTA has an urgent current need for 69 additional positions, which are summarized in Exhibit 2:.

	Position
• Total current staffing requirement per the MTA	61
• Additional staffing requirement per the Construction division, which have been denied to date by the MTA (Appendix 2)	10
• Minimum further additional staffing needs identified by Arthur Andersen in Contract Administration (5 positions), Cost Estimating (1 position) and Project Control (1 position)	7
Total current staffing requirement, as adjusted by us on the basis of the current scope of work of the Construction division	78
• Less staffing requirements related to Quality Control, if transferred back to the CMs	(9)
Total minimum urgent current staffing need	69

Exhibit 2

The need for 69 additional MTA staff personnel represents an increase of 50% to the actual headcount of 141 staff which is a significant challenge to the MTA for the following reasons:

- The hiring process has to be fast and efficient, in order to quickly fill open positions with the "best and brightest".
- The training and coaching by existing staff of the new hires has to be very focused, to quickly and efficiently integrate those "newcomers" into the MTA Construction Division.

Exhibit 3 illustrates the total required staffing level based on the position requirements outlined above.

Construction Division Staffing	Positions
Current Staffing	141
Total urgent current staffing needs, as above	69
Total minimum required staffing level for FY 95	210

Exhibit 3

We understand that the MTA constantly follows the practice of filling many open positions, as they become vacant or as a new need is identified and approved, with consultants' seconded employees. As already noted earlier in Chapter XIII on Safety and Chapter XIV on Quality, we do not concur with such a practice.

Seconded employees are not MTA staff. The MTA must play an oversight role on construction activity and is responsible for large expenditures of public funds. Such a role cannot be played long term with the same efficiency by seconded personnel, whose professional careers are not with the MTA. During short term transition periods, the use of seconded consultants' employees can be considered valuable to the Authority. Beyond such very short transition periods, issues related to the need for independent assessments or adequate protection of MTA's interest preclude such a practice from being a viable alternative.

5.0 Efficiency of the Human Resources Function

The Human Resource function is organized to provide support to the entire MTA organization. This fact alone does not prevent HR from providing effective service to the Construction Division. However, it should be noted that there can be vast differences in the Human Resource needs of various MTA divisions. To be effective, the Human Resource function must be cognizant of the specific circumstances and needs of each of these divisions.

Based on a status report of vacant positions prepared by the Construction Division's Program Management function, the following findings, related to time intervals experienced (all times in calendar days) in hiring approved but vacant positions, have been identified:

- Average time all current openings have been vacant = 97 days
- Average time experienced from request to advertisement of a position = 78 days
- Average time experienced from request to offer = 141 days

These findings are developed below:

a. **Existence and Length of Vacancies:** The Construction Division is expected to play an oversight role on large expenditures for the MTA despite, (a)experiencing important vacancies, and (b) enduring these vacancies over a significant period of time. We have evidence that the current situation is not an isolated case. Experiencing long-lasting vacant positions is a real threat to the control of construction expenditures for projects like MRL - Segment 2 which is scheduled to take approximately 83 months.

   The challenge of performing true design and construction oversight is made even more daunting when the vacancies experienced include the position of the Construction Executive Officer, vacant now almost six months.

b. **Excessively Long Hiring Process:** Construction Division managers have, on several occasions, voiced their concerns over the inability to quickly fill all their authorized positions. As the above figures demonstrate, on average, nearly five months elapse before a

request for a position results in an offer being made to a candidate. Of these five months, 55% of the delay is internal to the MTA, as illustrated in Exhibit 4.

	Days	%
• It takes the MTA 78 days, or more than two and a half months, to bring a job proposal to the market	78	55%
• It then takes 63 days, or two months, to hire the necessary skilled person	63	45%
Total	**141**	**100%**

Exhibit 4

Because most of the positions under active recruitment for the Construction Division require skilled management experience, limited opportunity exists to reduce the timing duration of two months from position advertisement to hiring. However, the time it takes the MTA to bring a job proposal to the market is far too long in absolute terms, and extremely long with respect to Construction Division challenges. When maintaining schedule and cost control are of the essence, an efficient organization should be able to advertise jobs as quickly as one to two weeks after the need has been identified.

Because of the very high number of current vacancies and additional staff needs covered in the preceding two sections, the foregoing efficiency problem needs to be fixed with urgency.

6.0 Project Management Plans

The total minimum required staffing level for fiscal year 1995 (FY 95) has been identified to be 210 positions for the Construction Division (see Exhibit 3 of section 4.0 above). This is 24 positions lower than the staffing requirement documented by the current Project Management Plans (PMP), after adjusting for the Division's current scope of work and for the effect of our recommendation on quality control. The adjusted staffing requirement documented for the PMP's are 234 positions for FY 95 as detailed in Exhibit 5.

Construction Unit Fiscal Year 1995		Positions
Requirement (1992 staffing plan)		255
• Less program reductions:		(26)
North Cost Extension	(4)	
Commuter Rail	(5)	
Segment 3 - Mid Cities	(10)	
Multi-Modal	(6)	
Pasadena Line Slowdown	(1)	
• Less: Public affairs and Transit Police positions transferred out		(25)
• Add: Quality and Safety positions transferred in		39
Staffing plan adjusted to the current scope of work of the construction division		243
• Less staffing requirements related to Quality Control, if such function is to be fully transferred back to the CMs		(9)
Adjusted staffing requirement documented for PMPs		234

Exhibit 5

Dealing effectively with such a difference is essential from both an internal and an external perspective.

Internally, we understand that the PMPs are the MTA's reference document for definition of scope, responsibilities, and resulting organization and staffing models for each rail construction project.

Externally, the two PMPs, concerning MRL - Segments 2 and 3, have been previously submitted to and approved by the Federal Transportation Authority.

In light of all of the above, the Division must immediately reevaluate or confirm the staffing requirements developed for the currently approved (internally or by the FTA) PMP's for each active rail construction project.

It must be noted that:

a. If the adjusted staffing requirements of 234 positions documented for PMPs was to be confirmed, the MTA would need to hire 93 additional MTA staff personnel. This would increase its current headcount by more than 65%, instead of the 69 positions or 50% increase identified in the previous section;

b. If the additional staffing requirements not authorized to date by the MTA, whether previously denied by the MTA or newly recommended by Arthur Andersen, was to be ignored in the comparison summarized at the beginning of this section, the difference identified there would become 41 positions instead of 24 positions.

The rationale followed to determine the adjusted staffing requirement of 234 positions, as documented for PMPs, is the subject of the remainder of this section.

In 1992, the Construction unit developed a long-term staffing plan to manage the envisioned rail construction program. Construction predicated this plan on the following assumptions:

Assumption 1: Specific projects would receive funding approval at specific times during the period

Assumption 2: Each project would traverse a similar life cycle from conceptual and preliminary design to detailed design and construction

Assumption 3: The Construction unit would continue its oversight role for all projects, with consultants fulfilling the perform role

Assumption 4: Each project would require a specific number of functional managers, based on a project model developed from past experience

As an example, a single Facilities Engineering Manager assigned to a project, can effectively oversee the design efforts for up to three station or tunnel contracts, provided the contracts do

not exceed a dollar value somewhere in the $85 million to $100 million level. Likewise, project team contract assignments produce the best results when each Facilities Engineering Manager is paired with an MTA Construction Manager to oversee individual contracts after the design has transferred to construction. Additionally, one Systems Engineering Manager can generally oversee the design, procurement and installation of as many as five systems contracts.

In this manner, project team models drive staffing needs based on an oversight span-of-control requirement. By forecasting the number of active rail construction projects in a given year, the number of contracts per project, the phase for each contract (design or construction), and the assumed dollar amount for the contract, Construction unit managers generated a staffing plan in 1992 for fiscal years 1993, 1994, 1995 and beyond.

To make the 1992 plan relevant to today's needs, we adjusted it for the various program changes which have occurred. Since 1992, the North Cost Extension plan for the Green Line has been dropped, along with the LAX-to-Palmdale project. The MTA has significantly curtailed the Commuter Rail and Multi-Modal programs as well. Concerns over hydrogen sulfide emissions have delayed the MRL - Segment 3 - Mid Cities project while MTA budgetary pressures have impacted the Pasadena Line schedule.

In addition, the 1992 plan had to be adjusted downward by 25 positions to account for the transfer of Public Affairs and Transit Police functions in 1993 from the Construction Division to other divisions of the MTA. Also, another 39 positions were added to account for the Quality and Safety positions required in November 1994 in response to FTA requests. Exhibit 4 illustrates the combined effect all of these adjustments.

7.0 History of Denied Staffing Requirements

As illustrated below, over the last two years the Construction Division endured constant and significant denial of staffing requirements by the MTA management. Furthermore, the Construction Division faced other obstacles over the last two years in staffing even to the level authorized and was sometimes forced to actually reduce its actual headcount.

In 1992, the Construction unit drafted several iterations of their staffing plan to refine position requirements. These plans detailed a need for up to 210 positions in fiscal year (FY) 1993, with a maximum staff of 271 positions by FY 1996. The Construction unit also developed a level 10-year plan, specifying a requirement for 181 positions in FY 93, and a constant 210 positions for FY 94, 95 and 96. To effectively oversee the anticipated rail construction plan, the Construction unit intended to fill the gap between requirements and the level plan by hiring consultants and contract employees.

In FY 93, the Construction unit required and LACTC-authorized a staffing level of 181. In advance of the merger to form the MTA, the LACTC accepted five RTD employees into the Construction unit, effectively increasing authorized staffing to 186. Headcount at that time totaled 177 employees, with 9 vacancies. See Exhibit 6.

Fiscal Year 1993	**Positions**
Requirement (1992 level staffing plan)	210
Level Staffing Requirement	181
Authorized Positions	186
Actual Staffing	177
"Authorized" Vacancies	**9**

Exhibit 6

In anticipation of FY 1994 needs for 210 employees, Construction was actively recruiting not only for the 9 vacancies, but also for an additional 24 positions. Actual staffing of 177 people, plus 33 new hires would have brought the Construction unit to the necessary level planning of 210 people for FY 1994. All 33 positions are listed in Appendix 1 in prioritized order of need.

In anticipation of the LACTC and RTD merger, all Construction unit recruiting was placed on hold. This action froze the nine authorized vacancies. For FY 1994, Construction requested approval for all 210 positions originally outlined in the 1992 level plan and expected to augment staffing to the full plan of 242. The MTA Office of Management and Budgeting (OMB) approved a Construction staffing level of 169 positions by transferring 25 positions for Public Affairs and Transit Police, to other divisions of the MTA and denying 16 of the requested positions (no positions were specified).

Through position transfers and forced headcount reductions, actual Construction staffing dropped from 177 to 147. Subsequent OMB directives reduced the authorized staffing from 169 to 161 positions. Exhibit 7 illustrates the staffing picture of FY 94.

Fiscal Year 1994	**Positions**
Level Staffing Requirement	210
Public Affairs and Transit Police Transfers	(25)
Adjusted Requirement	185
Authorized Positions	161
Actual FY 1994 Staffing	147
"Authorized" Vacancies	14
"Unauthorized" Vacancies	24
Total Vacancies	**38**

Exhibit 7

In FY 1994 Construction's staffing level of 147 represented a deficit of 38 positions, or 20% of the stated need. Nevertheless, in December 1993, further proposed reductions arrived in the form of an across-the-board cost reduction review. This review mandated that all Executive Officers identify annual labor and non-labor savings of 20%. For Construction, this equated to a 32 person headcount reduction and over $156 million in annual non-labor reductions. The OMB subsequently retracted the non-labor savings proposal and revised downward to 8 the requested staff reduction.

The MTA Construction Division managers continued to voice their concerns over these reductions. They noted that the MTA was mandating staff reductions at a point when construction activities were nearing their peak, making it difficult for the Construction Division to adequately manage its responsibilities on schedule and within budget. Additionally, Construction managers expressed that these actions would result in the MTA falling progressively further behind FTA understood and approved staffing levels. The FTA voiced similar worries in a January 1994 letter, stating that "hiring freezes are adversely impacting MTA and Construction staff responsible for Red Line Projects". The FTA repeated these concerns in a second letter to the MTA in March of 1994.

In response, the Construction unit proposed 12 new positions during May 1994. The OMB granted 3 of the 12 positions requested, bringing the total authorized staffing level for Construction to 164.

Appendix 2 lists the status of the positions originally requested by the Construction Division some two years ago. To prepare this appendix, we requested and reviewed written justification for each position listed as a continuing requirement. To date, the Construction Division requires 20 of the original positions which have yet to be filled. Currently half of these 20 positions are not under recruitment.

8.0 Implications of Our Findings

The MTA, through the Merger Advisory Group, the Office of Management and Budgeting and executive-level management made Construction unit staffing decisions without sufficient consideration for the true requirements of managing funded rail construction projects. This has hindered Construction Division efforts to actively and effectively manage most aspects of the rail construction program.

Uniform hiring freezes and staff reductions across the MTA indicate that MTA Executive Management does not fully understand or appreciate fundamental difference between its organizational elements.

The MTA has not effectively recruited and filled authorized and vacant positions in a timely fashion. This, too, has negatively impacted the Construction Division's ability to oversee the design and construction of rail projects. Many key positions have been authorized but remain unfilled due to hiring suspensions and cumbersome recruitment procedures.

Throughout our analysis of Construction's staffing requirements, we have experienced difficulties in obtaining the necessary data in a usable form. We find this disturbing given the importance of accurately determining position requirements to oversee rail construction projects. We also believe this is further indication of customer service breakdowns between support functions such as Human Resources and the Construction Division.

9.0 Our Recommendations

Recommendation #1: **The MTA urgently needs to hire a strong construction leader with extensive hands-on rail construction/tunneling experience** to head the MTA's Construction Division as the Executive Officer of Construction.

Recommendation #2: The Office of the Chief Executive Officer **(CEO) must provide trust and support to the future leader of Construction and to the Construction Division as a whole.** This can best be accomplished through hiring the contemplated Chief Operating Officer (COO) whose experience must include hands - on exposure to rail construction.

Recommendation #3: **The future leader of Construction must restore a team spirit among the Division's key managers and leaders.** The key to properly managing the construction activity will be energizing the Division, through its leaders, **around the shared value of urgently restoring the Division's oversight role.** This will require **an aggressive entrepreneurial spirit and approach**, coupled with clear evidence of such actions to demonstrate to all players (MTA staff, consultants, contractors, MTA Board) that the Construction Division is serious about protecting the MTA's interests. All players must be motivated **to fix the problem rather than the blame which will encourage people to take responsibility and accountability for their actions** rather than be risk adverse out of fear of retribution.

Recommendation #4: **The MTA urgently needs to significantly invest in human resources by (a) increasing the actual Construction Division headcount by at least 50%, (b) hiring some 69 skilled professionals and (c) upgrading the skills of current staff through training, coaching or other actions**

Recommendation #5: The efficiency of the Human Resources function, as it relates to the current needs of construction division, requires specific temporary organization change. **A "tiger team" or task force should be established immediately to serve Construction's Human Resource needs.** This task force would include additional HR personnel beyond the usual compliment that currently serves the Division. These additional people would also be co-located for the duration of the task force which would end when Construction's HR crisis has passed.

Recommendation #6: **The Division must reevaluate or confirm the staffing requirements developed for the currently approved project management plan (PMP) for each rail construction project.** These steps are required since, after adjustment to the current scope of work of the Division, actual current headcount appears to be 93 positions or about 65% short of the staffing requirements documented for the current project management plans (PMP). Two of those PMP's concerning Metro Red Line were submitted to and approved by the Federal Transportation Authority.

Recommendation #7: **The future leader of Construction must also establish an attitude of "healthy skepticism" within its staff as it relates to the contractual and business relationship with the Engineering Management (EMC) and Construction Management (CM) consultants.** This means: (a) clearly define what service is expected to be provided by the consultant (scope, schedule and cost); and then (b) play an effective oversight role on the consultant's deliverables, while maintaining the spirit of team work embodied in TEAMETRO.

Recommendation #8: **Seconded employees should be utilized only on a very temporary basis and MTA's open positions should be filled by MTA staff as quickly as feasible.**

March 1993 Construction Unit Staffing Need

No.	Position	Project	Status*
1	Deputy Project Manager - Construction	Pasadena Line	Proposed
2	Deputy Project Manager - Construction	Red Line - Seg 2	Frozen
3	Deputy Project Manager - Construction	Red Line - Seg 3	Proposed
4	Director of Engineering	Systemwide	Frozen
5	Director of Public Affairs	Systemwide	Frozen
6	Systems Engineering Manager	Pasadena Line	Frozen
7	Systems Engineering Manager	Red Line - Seg 2	Frozen
8	Senior Scheduling Administrator	Red Line - Seg 3	Frozen
9	Construction Manager	Red Line - Seg 2	Proposed
10	Contract Analyst II	Red Line - Seg 2	Proposed
11	Senior Configuration Specialist	Systemwide	Proposed
12	Contract Analyst II	Pasadena Line	Proposed
13	Contract Analyst III	Red Line - Seg 3	Proposed
14	Public Affairs Officer III	Red Line - Seg 3	Proposed
15	Agencies Coordinator I	Systemwide	Frozen
16	Project Assistant. Coordinator	Systemwide	Frozen
17	Facilities Engineering Manager	Red Line - Seg 3	Frozen
18	Safety Trainer	Systemwide	Frozen
19	Construction Manager	Red Line - Seg 3	Proposed
20	Public Affairs Officer III	Pasadena Line	Proposed
21	Public Affairs Officer II	Green Line	Proposed
22	QC Manager (Design)	Systemwide	Proposed
23	Facilities Engineering Manager	Red Line - Seg 3	Proposed
24	Public Affairs Officer II (TOPS)	Systemwide	Proposed
25	Senior Cost Engineering Administrator	Red Line - Seg 3	Proposed
26	Senior Systems Administrator	Systemwide	Proposed
27	Administrative Analyst II (Systems Safety)	Systemwide	Proposed
28	Contract Analyst	Rail Car	Proposed
29	Construction Manager	Pasadena Line	Proposed
30	Construction Manager	Red Line - Seg 3	Proposed
31	Contract Analyst II	Red Line - Seg 3	Proposed
32	Contract Analyst	LAX-Palmdale	Proposed
33	Administrative Assistant- Contracts	Systemwide	Proposed

* Frozen per February 12, 1993 Memo from Richard Alatorre

Appendix 1

Current Status of Original March 1993 Construction Staffing Request

No.	Position	Filled	Not Required	Transferred	Actively Recruiting	Required, but No Action
1	Deputy Project Manager - Construction, PL		X			
2	Deputy Project Manager - Construction, Seg 2	X				
3	Deputy Project Manager - Construction, Seg 3	X				
4	Director of Engineering - Systemwide				X	
5	Director of Public Affairs - Systemwide			X		
6	Systems Engineering Manager - PL				X	
7	Systems Engineering Manager - Seg 2				X	
8	**Senior Scheduling Administrator - Seg 3**					**X**
9	Construction Manager - Seg 2				X	
10	Contract Analyst II - Seg 2	X				
11	Senior Configuration Specialist - Systemwide				X	
12	Contract Analyst II - PL	X				
13	Contract Analyst III - Seg 3	X				
14	Public Affairs Officer III -Seg 3			X		
15	**Agencies Coordinator I - Systemwide**					**X**
16	Project Assistant. Coordinator - Systemwide	X				
17	**Facilities Engineering Manager - Seg 3**					**X**
18	Safety Trainer - Systemwide				X	
19	Construction Manager - Seg 3				X	
20	Public Affairs Officer III - PL			X		
21	Public Affairs Officer II - GL			X		
22	QA Manager (Design) - Systemwide				X	
23	**Facilities Engineering Manager - Seg 3**					**X**
24	Public Affairs Officer II (TOPS) - Systemwide			X		
25	**Sr. Cost Engineering Administrator - Seg 3**					**X**
26	**Senior Systems Administrator - Systemwide**					**X**
27	**Facilities Engineering Manager - Seg 3**					**X**
28	**Contract Analyst - Rail Car**					**X**
29	Construction Manager - PL				X	
30	Construction Manager - Seg 3				X	
31	**Contract Analyst II - Seg 3**					**X**
32	Contract Analyst - LAX-Palmdale		X			
33	**Admin Asst.- Contracts - Systemwide**					**X**
	TOTAL	6	2	5	**10**	**10**

Appendix 2

XVIII. List of Acronyms Used and Definitions

CHAPTER XVIII

Volume B

LIST OF ACRONYMS USED AND DEFINITIONS

ADA (Americans with Disabilities Act): Federal legislation requiring certain buildings, facilities, services and products be made accessible to those with disabilities.

AFE (Authorization for Expenditure): The total funds authorized for expenditure by the MTA Board for each contract. Generally, the AFE is equal to the contract amount and a "contingency" of 10 percent for processing Change Orders without further Board authorization.

AFR (Audit Finding Report): A report issued through the Quality Assurance function detailing results or findings of a quality audit.

AM (Area Managers): CM Personnel responsible for oversight of construction activities within a specified area comprised of several projects.

BAFO (Best and Final Offer): A request for a contractor or PSP to deliver a final proposal of costs to perform a specified service.

BART (Bay Area Rapid Transit): The transit authority established to provide regional rail transit services to the San Francisco Bay area.

CA (Contract Administrator): MTA personnel responsible for contract award activities and day-to-day contract oversight.

CCB (Change Control Board): A group of CM, EMC and MTA personnel responsible for reviewing and approving or rejecting Change Notices and Change Orders of $50,000 or more.

CCR: (Consultant Change Request): A request from a consultant/professional service provider for a contract change.

CCRB (Consultant Change Control Board): A group of MTA staff responsible for reviewing and approving or rejecting consultant contract changes of $50,000 or more.

CCS (Change Control System): An automated change tracking system that records and monitors , changes and generates documentation in support of RFI/RFCs, changes and claims created/submitted.

CM (Construction Management Consultant): A third party retained to supervise and manage construction activities with the oversight of the MTA.

CMS (Cost Management System): A comprehensive cost recording and monitoring system employed by the MTA integrating changes, budget and actual cost information.

CN (Change Notice): A notice to the contractor specifying a proposed change and requesting a cost and schedule proposal.

CO(Change Order): A formal modification to the contract. Considered executed and valid when signed by the appropriate CM or MTA approval level.

CPM (Critical Path Methodology): A methodology for project planning (scheduling) that records work tasks sequentially to address and identify the critical activity order and required milestones.

DBE (Disadvantaged Business Enterprise): A small business (as defined by the Small Business Administration) owned and operated by minorities or women.

EAC (Estimate at Completion): An estimate of the forecasted cost to complete a project based on its schedule, activity to date and an estimate of the cost of future work (also referred to as ETC [Estimate to Completion]).

EMC (Engineering Management Consultant): A third party retained by the MTA to provide program-wide design and engineering services.

FCE (Fair Cost Estimate): An estimate of the cost of a change prepared by CM estimators. This estimate is more detailed than the ROM and serves as the basis for negotiations with the contractor.

FFGA (Full Funding Grant Agreement): The grant agreement with the FTA for Metro Rail funding.

FTA (Federal Transportation Authority): Federal agency which has provided funds to the MTA for Rail Construction and monitors its actions.

LACMTA (Los Angeles County Metropolitan Transportation Authority): The single successor agency to the Southern California Rapid Transit District and Los Angeles County Transportation Committee.

LACTC (Los Angeles County Transportation Commission): Predecessor organization to the MTA responsible for rail construction activities.

MARTA (Metropolitan Atlanta Rapid Transit Authority): The transit authority established to provide transportation service to metropolitan Atlanta.

MBE (Minority Business Enterprise): A business enterprise owned by a minority.

MOS (Minimum Operable Segment): Smallest portion of the Metro Rail System that can be viably constructed and operated.

MRL (Metro Red Line): Heavy rail and underground subway system which will eventually serve downtown Los Angeles, Mid-Cities, Hollywood and North Hollywood areas.

MRTC (Metro Rail Transit Consultants): The organization that was the predecessor to the EMC for design and engineering services on the MRL.

NCR (Non-conformance Report): A report issued by the CM when the work of the general contractor is not in compliance with its submittals or contractual terms.

NTE (Not-To-Exceed Level): A dollar limit specified during the change order process limiting the contractors/consultants to only incur a set amount of cost for work performed prior to the final Change Order pricing negotiations.

NTP (Notice to Proceed): An authorization issued to a contractor stating the work under contract is to be initiated on a specific date.

OCIP (Owner Controlled Insurance Program) The core of construction risk management programs established for managing and meeting the MTA's insurance needs.

P-B/DMJM (Parsons-Brinckerhoff/ Daniel Mann Johnson Mendehall) [EMC]: The joint venture providing project-wide design engineering services.

PBCR (Project Budget Change Request): A request from Project Control personnel to amend the project budget based on forecasts and contract amendments and changes.

P-D (Parsons-Dillingham) [CM]: The joint venture providing CM services on MRL- Segment 2.

PCE (Project Control Engineer): The CM staff that monitors and provides contract cost and schedule control/monitoring/reporting.

PERC (Partnership for Excellence in Rail Construction): Official MTA total quality management program.

PIP (Project Implementation Plan): A document defining the scope of professional design services for each rail construction project.

PM (Project Manager): The MTA staff with overall responsibility for an MOS or other rail transit project.

PMOC (Project Management Oversight Consultant): A third-party consultant retained by the FTA to review and provide recommendations for federally funded rail construction projects.

PMP (Project Management Plan): A detailed plan for managing Metro Rail construction activities which defines the roles and responsibilities of the MTA, EMC and CM.

PMSR (Project Manager's Status Report): A monthly report prepared for each rail segment that discusses schedule, cost, safety and staffing issues.

PSP (Professional Service Providers): A third-party consultant retained by the MTA to perform a specified service.

PUM (Project Unit Managers): EMC personnel responsible for oversight of design activities for a limited number of project contracts.

QA (Quality Assurance): All planned and systematic actions necessary to provide adequate confidence to management that a product or service will satisfy given requirements for quality.[1]

QC (Quality Control): The operational techniques and activities that are used to fulfill requirements for quality.[1]

QPS (Quality Policy Statement): Official MTA pronouncement regarding quality issues comprised of 14 separate statements covering different elements of quality.

RCC (Rail Construction Corporation): The former subsidiary corporation of the LACTC responsible for the design and construction of rail systems.

RE (Resident Engineer): The authorized representative of the CM charged with field professional administration of construction and systems contracts.

RFC (Request for Change): A request from the contractor for additional time, contract/design change or additional compensation.

RFI (Request for Information): Request for design or other information not sufficiently detailed/explained in the contract documents. May be generated by contractor, EMC or any MTA staff member.

RFP (Request for Proposal): A document requesting a contractor or PSP to provide a proposal for services detailing such things as general skills and qualifications, DBE potential and technical specifications.

RFIQ (Request for Information & Qualifications): A document requesting that a contractor or PSP provide general information and its qualifications to provide services required by the MTA.

ROD (Revenue Operations Date): The date on which an MOS or other rail project is placed in service for use by the general public and is generating revenues.

[1] "Quality Management and Quality Assurance Standards-- Guidelines for Selection and Use," ANSI/ASQC Standard Q90- 1987, American Society for Quality Control, Milwaukee, WI, 1987.

ROM (Rough Order of Magnitude): A preliminary estimate of the cost of a change which is generally prepared by the RE or EMC.

SAP (Safety Awareness Program): A program which provides financial incentives to contractors for meeting certain safety standards.

SCRTD (Southern California Rapid Transit District): Predecessor to the MTA responsible for the operation and maintenance of the LA Metro Bus System.

SSPP (System Safety Program Plan): A plan outlining the MTA's process for ensuring the safety of the constructed rail system.

WACN (Work Authorization Change Notice): A Change Notice which allows the work to proceed up to a defined cost while negotiations or other final pricing can be completed.

WBE (Woman Business Entity): A business entity owned by a woman.

WMATA (Washington Metropolitan Area Transit Authority): The transit authority servicing metropolitan Washington, D.C.

WPI (Work Process Improvement): Part of the PERC program whereby MTA employees and consultants can initiate a team to improve a work process.