



Alan F. Pegg
General Manager

July 27, 1989

To: Board of Directors
From: Alan F. Pegg
Subject: Executive Summary, High-Point Schaer Audit of
Metro Red Line Project Costs

On June 23, 1989 I reported to the Board that cost trends on the Metro Red Line project mandated a review and analysis of the project and development of actions that could be taken to reduce costs. Attached is a recently-completed draft executive summary of a cost review conducted by High-Point Schaer, an independent engineering firm hired by the District to evaluate the project's overall estimated final cost as a result of nearly three years' construction experience.

The attached draft cost review by High-Point Schaer estimates that the project may finish 5 to 8 percent over the original estimate, or between \$64 million and \$102 million. High-Point Schaer also states that another extension in completion of the project may occur. However, the firm is careful to note that a number of factors could change these estimates, including unawarded contracts and the actual settlement value of unresolved contract claims. As you are aware, outside counsel has been hired to determine the District's likely real costs of outstanding claims.

High-Point Schaer further recognizes that the District's planning for and application of contingency funds is "conservative", allowing for possible further savings later in the project. High-Point Schaer suggests, in fact, that the final cost can be reduced depending upon how the contingency is managed.

Staff has completed its own internal review and estimates the final cost of the project may increase \$104 million over the original cost estimate. The SCRTD's construction management firm of Ralph M. Parsons Company, Dillingham Construction Inc., and Deleuw, Cather and Co. has conducted its own cost review and estimated that the final cost may be \$80 million over the original budget. Staff also has developed a number of cost reduction ideas, which are being evaluated for implementation.

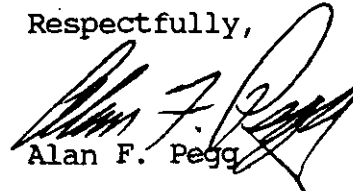
It should be recognized that all of these reviews, including the audit being conducted for the Los Angeles County Transportation Commission, are financial estimates, and should be considered as such. The SCRTD has instituted some of the most sophisticated tracking procedures to monitor costs, allowing District management the tools required to insure maximum control of the project.

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Further, the original full funding contract provided a contingency in the event that MOS-1 project costs exceeded the original estimate, and that the Capital Reserve Account (CAPRA), containing funds from both the City of Los Angeles and the LACTC and amounting to 20 percent of the project's total costs is available. Current projections indicate only a fraction of these funds will be needed.

The final report from High-Point Schaer is to be delivered to the District in mid-August. Actions to be taken to control costs will be presented to the Board beginning at the July 27 meeting.

Respectfully,



Alan F. Pegg

PRELIMINARY DRAFT REPORT
METRO RED LINE PROJECT
ESTIMATE ASSESSMENT

**SOUTHERN CALIFORNIA
RAPID TRANSIT DISTRICT**

**PREPARED BY:
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July 21, 1989

VOLUME I

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I. EXECUTIVE SUMMARY

On June 23, 1989, High-Point Schaer entered into a contract with Southern California Rapid Transit District (SCRTD), for the purpose of conducting an assessment of SCRTD's Estimate at Completion for the Metro Red Line Project Phase I, MOS-1. High-Point Schaer was provided with all pertaining information and allowed free access to all members of SCRTD's staff as well as the staffs of SCRTD's General Engineering Consultant, Metro Rail Transit Consultants (MRTC), the Systems Engineer and Analysis Consultant, and the Construction Management Consultant (PDCD) and select contractors.

For a frame of reference, High-Point Schaer was instructed to utilize a cut off date of May 31, 1989 as a base line to the estimate assessment. High-Point Schaer's scope was not to be considered a re-estimation of the Cost to Complete, but rather a testing and verification of the District's methodology and judgement utilized in developing their Estimate to Complete. High-Point Schaer was instructed to approach the assignment in a purely objective and unbiased manner.

In conducting the assignment, High-Point Schaer first examined the methodology SCRTD utilized in developing their Cost to Complete. High-Point Schaer examined each line item of the Estimated Cost to Complete and the individual components, allowances and contingencies applied to each line item. High-Point Schaer performed a technical review of the status of ongoing construction work as well as an evaluation into unawarded contracts. Based upon the findings derived from this investigation, High-Point Schaer reassessed and adjusted several of the cost components on a job by job basis. High-Point Schaer then recalculated the Estimated Cost to Complete to derive an independent assessment value.

High-Point Schaer's value was then compared to SCRTD's Estimated Cost to Complete, and thereby formed the basis of our conclusions. Section IV herein addresses the assessment of SCRTD's Estimate to Complete, and Section V addresses High-Point Schaer's reassessment of the overall program.

Since the time available to conduct the Estimate Assessment was limited, and since the size of the Metro Red Line Program is large, High-Point Schaer mobilized on the day of contract award, a team of one project manager, three senior level engineers, a construction accountant, a system analyst and other home office support personnel.

SUMMARY OF FINDINGS

High-Point Schaer finds and hereby verifies that the District's projected cost overrun of \$104,000,000 is a reasonable on MOS-1. However, this is based on a probable extension of schedule and other adjustments to SCRTD's estimate.

In conducting the review, and in arriving at the above conclusion, several interesting factors came to light which must be taken into account in High-Point Schaer's affirmation of the Estimated Cost to Complete. Those factors fall into two categories as addressed in the report herein: Section IV, Assessment of SCRTD's Estimate to Complete, and Section V, Reassessment to Complete. Without consideration given to SCRTD's final determination of Cost to Complete, High-Point Schaer performed a line-item by line-item evaluation and reassessment of several technical factors within the program. The total of "adds" and "deducts" through High-Point Schaer's reassessment, essentially balance, however, when one considers the absolute value of the "adds" and "deducts", the difference is of some

significance. Further, the process of assessing the cost to complete has raised certain issues which deserve some attention.

SUMMARY OF SECTION IV, ASSESSMENT OF SCRTD'S ESTIMATE TO COMPLETE

In assessing SCRTD's Cost to Complete, High-Point Schaer finds, as contained in Section IV herein, the following:

Unawarded Contracts

- For unawarded contracts - contingency amounts were included within the original estimates, as were mid-point of construction cost escalation factors. For 1989 estimated projects, SCRTD has taken these already factored estimates, and further provided another layer of cost escalation, as well as an additional 10% contingency. The net result is a total contingency on unawarded contracts of the order of 20%.
- Pertaining to Schedule Revision allowances on unawarded contracts. The District has included additional funds for Scheduled Revisions as a result of Revision 7 for 1989 estimated projects despite having already escalated cost as described above. On top of this Schedule Revision allowance, the District has included an additional 10% contingency.
- Pertaining to un-booked changes and claims on unawarded contracts, the District has selected to make allowances for such costs. However, in

addition to these allowances, the District has taken an additional 10% contingency.

- For unawarded contracts, the District has effectively applied \$22,219,883 of allowances and contingencies to a total value of unawarded work of \$73,091,346 or 30.47%.

Awarded Contracts

- The District has taken an additional 10% contingency on top allowances including; CCB potential changes, Schedule Revisions, Claims, Un-Booked Changes and Claims. Since these allowances are essentially contingency funds, the application of a final 10% on the bottom line appears to double count contingencies.
- Pertaining to Schedule Revisions on awarded contracts, High-Point Schaer found that this funding category was susceptible to be duplicated through other allowances such as potential claims, and un-booked changes.
- The summary of allowances for awarded contracts reflect that SCRTD has taken \$78,423,005 in allowances and added an additional 10% contingency of \$7,842,199 in order to arrive at a total plus contingency amount of \$86,265,304 to be applied on top of the awarded contract value of \$532,390,536 or 16.2% or 26.0% of the contract amounts.

Master Agreements

- Of the \$16,592,550 allotted for the Metro Red Line portion of the Master Agreements, High-Point Schaer finds that the District to date has only expended approximately 25%. From the interviews conducted and the documentation reviewed, it appears highly unlikely that the full amount allotted for Master Agreements will be expended. Therefore, it appeared to High-Point Schaer to be unnecessary to apply an additional 10% contingency on top of Master Agreements.

Conclusion of SCRTD's Estimate Assessment

High-Point Schaer finds that the SCRTD's taking of contingency amounts on top of allowances reflects a conservative approach in the development of Estimated Cost to Complete. However, the amount included in a project budget as a contingency is considered a management decision. High-Point Schaer suggests, alternate methods of both estimate analysis and applying contingencies so as to reduce any duplication in cost between allowances and contingencies and further to reduce any duplication between cost escalation factors for unawarded contracts.

SUMMARY OF SECTION V, REASSESSMENT TO COMPLETE

In reassessing SCRTD's Cost to Complete, in terms of the technical factors High-Point Schaer finds, as contained in Section V, herein:

- The master schedule used for the SCRTD budget was found to not completely reflect the actual progress of projects in all cases

- Certain selective allowances were made without specific supporting documentation or apparent issues, i.e. on occasions allowances were made based upon best judgement of estimators without reference to any tangible event or specific cause
- Two key factors clearly stood out of the schedule reassessment, 1) all station and tunnel contracts, but one, are behind schedule, and 2) one contractor is significantly behind schedule
- It appears the delay in one of the on-going contracts has the potential to impact tunnel work associated with one of the stations and to further delay track work in those tunnels and associated stations and ultimately delay the completion of the project by as much as nine months
- The delays to construction, have a potential to extend both the general consultant, construction manager and agency overhead components
- In the evaluation of individual projects, there are numerous specific findings pertaining to those contracts. See Appendix B, herein.

In summary, High-Point Schaer finds that the District's Estimated Cost overrun of \$104,000,000 reflects a fair and reasonable prediction when considered in total. Through High-Point Schaer's reassessment of each of the project line items, and subsequent redevelopment of those adjusted values, High-Point Schaer has independently arrived at a Total Estimated Cost Overrun of \$102,000,000.

Further, as summarized above and detail in the following report, High-Point Schaer believes that some of the contingency applications reflect a highly conservative value and therefore, represent an area in which the total program budget can be safely economized. While still taking a somewhat conservative approach, High-Point Schaer has utilized an alternate form of contingency applications and derived an alternative revised Total Cost Overrun of \$87,000,000 when comparing with the District's Estimated Cost Overrun. The overrun could be further reduced should a more rigorous viewpoint be taken on application of contingency.

The assessment of SCRTD's Estimate to Complete is based upon conditions as they exist on May 31, 1989. There are certainly potential factors which hold the possibility of negatively impacting the overall cost of the program, and exceeding the above stated Estimated Cost Overruns.

II. BACKGROUND ON ASSESSMENT

A. INTRODUCTION AND PURPOSE OF ASSESSMENT

High-Point Schaer was retained on June 23, 1989 to provide an independent review and evaluation of all data used by Southern California Rapid Transit District (SCRTD) in the generation of SCRTD's estimate to completion for MOS-1 of the Metro Red Line Project. Work commenced with a kick-off meeting on June 23, 1989. On July 21, 1989 a preliminary report was submitted coupled with an oral presentation to the District summarizing the findings contained therein. The District reviewed High-Point Schaer's findings and thereafter, the District's comments were incorporated into a final report submitted to the District on ???, 1989.

The current assignment is referred to by High-Point Schaer as the Estimate Assessment of the SCRTD Metro Red Line Project. The Estimate Assessment for SCRTD is the fourth assignment High-Point Schaer has completed for the District. Previous High-Point Schaer assignments include the following:

- Review of SCRTD Change Order Procedures - Completed January, 1988
- Conduct Construction Claims Prevention Workshop - Completed, 1988
- Review SCRTD Claim Management Procedure - Completed April, 1989

The purpose of the Estimate Assessment for SCRTD is to validate and or adjust what SCRTD has already compiled through both in-house estimating and PDCD estimating. The goal of the assignment was to assess the total Metro Red Line program through the examination of each cost element including individual line items to a detail sufficient to provide SCRTD with a reasonable level of assurance that the prepared estimates are a reasonable forecast of the ultimate project cost.

The only component left out of High-Point Schaer's Estimate Assessment, was the review and evaluation of all construction claims made to date. The claims evaluation is part of a separate contract being performed by the law firm of Lillick & McHose and coordinated through OCPM of SCRTD.

One of the more important components of High-Point Schaer's Estimate Assessment was in the examination of current contract status in order to develop a fair prediction of cost for change orders not yet issued, claims not yet received, and other potential events holding the promise of negatively impacting the cost of the overall program. As such, High-Point Schaer's assignment entailed an element of subjectiveness on the part of the engineers involved in the effort. Because of this, the individuals assigned to the assignment represented High-Point Schaer's most experienced consultants; John Smith, William Gardner and Jerry Epps, representing more than 75 years of combined construction/project management experience.

In order to yield the most meaningful results within the limited time available, High-Point Schaer's effort was focused upon those elements of the overall program which were most suspect or susceptible to cost overruns, and those elements of greatest dollar value. In summary, the broad cost categories covered herein include

estimates of completion for; unawarded contracts, awarded contracts, master agreements and overhead costs.

1. **Scope of Work.** High-Point Schaer's scope of work as contained in the contract between High-Point Schaer and the SCRTD, contract number 9-8100-498, is included in Appendix A-1 herein.

In summary, the scope required High-Point Schaer to review all data used by the District to generate its estimate to completion for MOS-1 of the Metro Red Line Project and any other data High-Point Schaer determined necessary in order to:

- Analyze and verify or revise the estimated completion cost for the scope of work of each awarded construction/procurement contract. Special attention was given to identified and potential changes to each contract.
- Analyze and verify or revise the estimated completion cost for the scope of work for each construction/ procurement contract to be awarded. Special attention was given to any trends in contract changes identified in analyzing awarded contracts to determine if any past experience is applicable to unawarded contracts.
- Analyze and verify or revise the estimated completion cost for major consulting contracts.
- Analyze and verify or revise the estimated completion for all District related cost.

In order to perform the above analysis, High-Point Schaer mobilized an assessment team, see Section III-A, herein. The team examined the methodology and basis for each line item contained in the District's estimate to complete. This required gathering all data generated by the District and examining that data for completeness and correctness. The team developed an independent database for the purpose of analyzing the District's generated estimate of completion in a systematic and comprehensive manner. Integrated into High-Point Schaer's Estimate Assessment was the District's reserve for contractor's claim (provided by separate contract) for awarded and unawarded contracts.

2. Kick-Off Meeting and Follow-Up Summary. On June 23, 1989, a kick-off meeting was held at SCRTD's offices in Los Angeles with the key members of the SCRTD project team involved in the development of SCRTD's estimate to complete. Representing the SCRTD at the meeting were the following individuals:

Jeff Christiansen, Director of Project Control
T.L. Johnson, Director OCPM
John Bilich, Estimating Manager
Louisa Simpson, Program Control Manager
Paul Schneider, Program Control Manager (Cost)
Norm Crawford, Program Control Manager

At the kick-off meeting Jeff Christiansen explained that there were three key elements of High-Point Schaer's assessment of the SCRTD estimate to complete

which held the greatest potential for cost overrun. Those three elements included the following:

- Those claims and changes that have already been submitted by contractors;
- Those claims and changes which have not yet been submitted by contractors, but are either already identified or are unidentified potential events;
- Those lessons learned from previous contracts which should be applied to unawarded contracts so as to reflect a more accurate estimate of the ultimate award value of said contracts.

High-Point Schaer was informed that it would not be involved in the area of real estate cost. SCRTD has made arrangements for independent appraisals for which High-Point Schaer will be provided for inclusion in the Estimate Assessment.

SCRTD provided to High-Point Schaer the contract line item estimated cost to complete report dated May 31, 1989. Further, High-Point Schaer was provided design/procurement/construction - schedule and financial plans for all "other" costs, dated March 31, 1989. High-Point Schaer was informed that said documents were to provide the baseline for any further analysis, i.e. we were to freeze events as of May 31, 1989.

Based upon SCRTD's estimate to complete, the SCRTD has determined that there is an approximate \$104 million cost overrun on the Metro Red Line Project. This figure has had factored into it schedule slippages and represents a number that the district has confidence in. Relative to the overall schedule, SCRTD has

determined a new Revenue Operating Date (ROD) of January, 1993. SCRTD has no reason to suspect any further slippages of this date.

HIGH-POINT SCHAER'S ESTIMATE ASSESSMENT TEAM. After the District had completed their briefing on the assignment, the High-Point Schaer team provided a summary of the work plan over the next four weeks and an explanation of the proposed methodology to be used in High-Point Schaer's Estimate Assessment. A briefing package was handed out to all kick-off meeting participants and is contained in Appendix A-2 herein.

In summary, High-Point Schaer's basic approach was to examine each contract line item on an individual basis and all estimates and/or pertinent documentation supporting the SCRTD's estimate to complete. Interviews were to be conducted commencing first with SCRTD's in-house personnel and advancing through the organizations of MRTC, PDCD and lastly, on a selective basis, various construction contractors. The split up of areas between the assessment team members would be as follows: John Smith responsible for all procurement contract and "other" cost; William Gardner responsible for all station contracts either awarded or unawarded; Jerry Epps responsible for all tunneling contracts either awarded or unawarded; Sam Peck responsible for all SCRTD force account cost; and Scott Jones responsible for implementation of the Estimate Assessment database and the compilation of all cost elements.

B. OVERVIEW OF PROJECT SCOPE

The Los Angeles Metro Red Line Project is a phased construction effort that will eventually result in an 18-mile rail rapid transit line extending from the central business districts through Wilshire Boulevard area to Fairfax Avenue and then north through Hollywood to the San Fernando Valley. First stage of the project is termed Minimum Operable Segment-1 (MOS-1). The 4.4-mile MOS-1, shown in Exhibit II-2, includes a yard shop area and a main line route served by five stations. The main line route will begin at Union Station, run through the Central Business District on Hill Street and continue to the Wilshire/Alvarado Station, where the line will terminate. The main line will be entirely in subway, with line segments constructed by tunneling machines and stations and cross-overs excavated by cut and cover construction techniques. Vehicles for the system will be stainless steel, 75 foot long rail cars which will be configured in pairs. The system of operation will be centrally controlled from the rail control center, using communication links with facilities and trains involving telephones, radios, closed circuit televisions and data transmissions.

As the program currently stands, May 31, 1989, there are 63 individual construction/procurement contracts that SCRTD will ultimately award in order to complete MOS-1. Of the 63 total contracts, 35 are awarded, 7 completed and 28 either under construction or in the manufacturing phase, and 28 yet to be awarded. Approximately 90% of all construction procurements have been awarded. Of the remaining contracts to be awarded, only four are of any significant size, and these involve the finish work to the stations. Overall, the project is reported by SCRTD as 35% complete.

1. Project Participants. The detailed final design was performed by the District's general engineering consultant, Metro Rail Transit Consultants (MRTC), a joint venture of Daniel, Mann, Johnson & Mendenhall/Parsons, Brinkerhoff, Quade & Douglas/Kaiser Engineers (California) Corporation/Harry Weese & Associates. The systems engineering and analysis consultant is Booz-Allen & Hamilton, and the Construction Management Consultant is a joint venture of Ralph M. Parsons/Dillingham Construction/DeLeuw, Cather & Company (PDCD). Exhibit II-1 sets forth the Metro Rail core project team.

2. Project Job and Overhead Components. As described above, MOS-1 consists of 63 contracts of which 35 are awarded and 28 unawarded. SCRTD's estimated cost to complete summary report forms the baseline for High-Point Schaer's assessment of the estimate. SCRTD's baseline provides line item information for each of the awarded and unawarded contracts. Included therein are contract award amount, executed change orders, potential changes, amounts for schedule revision, potential claims, assessment of un-booked changes and claims, and subtotals. Also included is a comparison between the PDCD assessment and the SCRTD assessment of each of the above.

Included in all direct costs are all master agreements. There are 10 master agreements with various other public agencies including the City of Los Angeles, Caltrans, the County of Los Angeles, etc. Master agreements, as determined by SCRTD, amount to \$19,050,000 of which \$16,591,180 is allocated to the Metro Red Line and the balance to LRT.

The total of all direct costs, as determined by PDCD and SCRTD, to complete MOS-1 are as follows:

	<u>PDCD</u>	<u>SCRTD</u>
Awarded Contracts and Procurements	\$549,425,694	\$572,032,579
Unawarded Contracts	84,249,454	86,122,014
Master Agreements	<u>16,591,180</u>	<u>16,591,180</u>
Total of all direct cost to complete	\$650,266,328	\$674,745,773

Note: The above totals were obtained from SCRTD's cost to complete report dated May 31, 1989.

OVERHEAD COST. The SCRTD overhead cost, as contained in the cost to complete report dated May 31, 1989, are as follows:

	<u>Indirect Cost</u>
General Consultant	\$166,893,000
Construction Manager	94,494,000
Construction related to services	11,814,000
Design related services	12,928,000
Agency	119,974,000
Right-of-way	112,245,000
OCIP	53,603,000
Preliminary Engineering	32,000,000
	=====
Total =	\$622,155,000

C. ASSESSMENT, OVERALL METHODOLOGY

The following sections provide a broad overview of the methodology utilized in the High-Point Schaer Estimate Assessment assignment. Sections II-C.1, II-C.2, and II-C.3 correspond to findings as contained in Sections III, IV and V respectively.

1. **Methodology of Assessment.** Since High-Point Schaer's assignment is essentially one to evaluate and review the SCRTD's existing estimate to completion, the basis for the methodology was one which closely paralleled the form and format of SCRTD's prior work. High-Point Schaer's approach was first to gain an understanding of the method SCRTD utilized in compiling all the costs of the program and in SCRTD's application of certain contingency amounts.

High-Point Schaer's evaluation basically fell into two broad categories: 1) accounting review of hard dollar costs and the accuracy of the application of various mark-ups to those hard dollars amounts, and 2) a subjective analysis of potential claims, schedule slippages and other factors which might negatively impact the overall cost program.

A database was established which provided for an integrated analysis of SCRTD's estimate to complete. Interview guidelines were established and data entry forms created in order to capture all of the relative information. The database was structured such that it could be easily updated in the future should any reassessment be required by SCRTD.

The assessment team commenced the assignment with the development of a detailed work plan and work schedule. Work plans and work schedules were

updated weekly, and the SCRTD was provided two interim briefings on June 30 and July 13. All documentation transmitted to SCRTD during the course of the assignment is contained in Appendix A-2 herein.

In conducting the assessment of SCRTD's estimate to complete, High-Point Schaer performed the following tasks:

- a) Job estimates for unawarded contracts were reviewed and all appropriate participants interviewed. The assessment focused on the status of design, historical trends from awarded contracts, potential for changes, and anticipated scheduled award date.
- b) Evaluation of awarded contracts and interviews with all appropriate parties. A significant amount of work effort went into this portion of the analysis. The evaluation focused upon the current status of construction, "booked" changes and claims, schedule slippages, contractor performance trends, potential for future claims, and possible ripple effect from one contractor to the next.
- c) All "other" costs were reviewed in a similar fashion to the above two.
- d) High-Point Schaer reassessed the overall construction schedule for MOS-1 and reassessed cost based upon this revised schedule.
- e) High-Point Schaer thoroughly evaluated SCRTD's application of contingency amounts and revised the method of application in order to clearly relate contingency amounts to potential risks, and in order to eliminate any possible

duplication of contingency amounts, and lastly in order to provide a reasonable basis for setting aside funds for events yet unknown.

The details and findings of High-Point Schaer's review are presented in more detail in Section III - Methodology of Assessment contained herein.

2. Assessment of SCRTD'S Estimate To Complete. The basic methodology utilized in the assessment of SCRTD's estimate to complete, focused upon four major areas of evaluation, those being: unawarded contracts, awarded contracts, master agreements and other costs.

The analysis method applied to the estimate of completion was built around a central database composed of a number of different fields. Base data was entered for each of the four major categories as derived from SCRTD provided data. A series of analytical steps were then set up for each of the four categories. With such items taken into account as the uniform application of cost escalation factors, handling of contingencies, application of schedule reserves, assessment of un-booked changes and claims. Next, the quality of SCRTD's estimate to complete was tested against base line criteria for each of the estimate line items. Based upon the results of the above evaluation, an assessment of the allowances was made and an explanation provided tying allowances back to specific supporting documentation and/or observations. Once again, the goal here was to provide visibility to all cost elements and to avoid any possibility of double counting or unnecessarily applied "hidden" costs without adequate explanation.

3. Reassessment of Estimate to Complete. Based upon the over 100 interviews conducted by the assessment team and based upon an evaluation of

project documentation including estimated cost to complete, schedules, cost reports, and performance records, High-Point Schaer has derived an independent assessment of the potential exposure SCRTD may face on anyone of the given line items. This evaluation provided the basis for adjustments and revisions to SCRTD's cost to complete when it was found that SCRTD had not adequately taken into account uncovered impacts.

All subjective interpretations contained in High-Point Schaer's assessment are contained in a single line item, Un-booked Claims and Change Orders. Costs were only assigned to the field when specific cause of action, or fact, or supportable opinion could be derived. "Gut feelings" and other such broad based allowances for this field were eliminated. Since there is a field for scheduled revision, i.e. Schedule Revision items, the team was very careful in cross-verifying between the un-booked change orders and scheduled revisions allowances to be certain that no duplication of costs existed.

High-Point Schaer's finding and supporting analysis is contained in Section V, Reassessment of Estimate to Complete, contained herein.

4. Comments on Data Interpretation. Given the limited time available, High-Point Schaer has taken every effort possible to maintain the integrity of data collection, and verify from at least two sources, any observation and/or opinion voiced by the project participants who were interviewed. The analysis and data presented hereforth is based upon what information the SCRTD provided and what information was gathered through the conducting of interviews. When appropriate, High-Point Schaer devoted special attention to selected features of the Estimate Assessment when particular areas became suspect or especially susceptible to cost

overruns and delays. The work completed is comprehensive and exhaustive in nature. Nevertheless, there does exist potential issues which remain that are not definable or discoverable to the level of review conducted herein or within the time frame allowed. For instance, there are a number of claims made for which contractors have failed to submit any dollar values. To the extent possible, High-Point Schaer has attempted to cover this impact in the data field Un-Booked Claims and Change Orders. However, given the complicated nature of some construction claims, and multiplicity of issues involved, and the limited time available the High-Point Schaer assessment on any given issue/claim may be on a significant order of magnitude either too high or too low.

For the program as a whole, and therefore the overall cost to complete estimate, High-Point Schaer stands behind the report presented herein. The information presented is a fair assessment and reasonable prediction of SCRTD's projected final cost on the Metro Red Line Project, as of May 31, 1989.

5. Practice and Policy on Budget Contingency and Allowance.
Management of budgets, estimates and costs for a major and complicated program is a difficult task. The informational requirements and needs vary considerably between parties and over the span of a project. Each participant, for its purposes establishes procedures and practices which best serve its operational needs and requirements.

The program control group has established a series of practices and policies to link other and external sectors of the program into the program's informational requirements as well as to serve the Metro Red Line Project and SCRTD's management requirements. Given Program Control's function, staffing and location

in the organization of the project, and in the system of information development, they have selected reasonable and sound methods for providing project control information. The information developed reflects their ability to obtain, process and analyze the necessary management information in a complex program organizational structure and information flow.

III. METHODOLOGY OF ASSESSMENT

A. GENERAL APPROACH

High-Point Schaer's approach was first to examine the mechanics and methods used by SCRTD in compiling the cost to complete spreadsheet provided at the onset of the assignment. High-Point Schaer examined various categories of allowances, including potential changes and claims, CCB potential changes, schedule revisions, and other factors in developing the direct cost of the program. Further, High-Point Schaer examined the application of contingencies in determining what the net contingency was for each line item.

The general approach was to tie as much of the estimate down to specific supporting estimates, documentation, or potential events as possible. Contingencies were examined to eliminate any possible duplication or double counting, and also to reflect reasonable prudent values given the status of the program, and historical trends.

In order to fully examine the District's Estimate to Completion, High-Point Schaer reviewed a number of different documents and conducted a series of interviews starting first with SCRTD estimating staff and then advancing through SCRTD Project Managers, Contract Administrators and other members involved in the preparation of the estimate. Interviews followed with MRTC, and PDCD, and on a selective basis, General Contractors.

Information gained from the document reviews, and interviews, was compiled on various interview guideline forms and job analysis forms contained in Appendix A

and B. From there data was entered into an estimate assessment database in a format consistent with and closely paralleling the SCRTD's estimate to complete spreadsheet. The final results of High-Point Schaer's Estimate Assessment are contained in Appendix A-3-5 herein.

1. Document Review. High-Point Schaer's field team reviewed all available documentation pertaining to the current estimated value of the project. Below is a list of the main documents reviewed.

- Monthly Status Reports - April and May 1989
- SCRTD Spread Sheets (J. Bilich)
- Level I, II & III Schedules (Rev 7 by project)
- Executive Schedule April 1989
- Level II Working Schedule
- PDCD Project Schedule Evaluation Analysis & Assumption dated 5/15/89 (Data Date 3/10/89)
- PDCD Change/Claims Exposure Analysis (6/15/89)
- MOS-1 Construction Estimate - Contract Unit History (purchased by Program Control May 3, 1989)

- Sequential Claims Listing by Contract (cut-off 5/26/89)
- Change Order Log
- MRTC Engineering Estimates
- Misc Calculation Sheets from SCRTD (Backup to SCRTD Spread Sheets)
- Summary ROD - Extension Costs (Probable Case) (3/20/89)
- Case III Probable Schedule (Cost for Changed Conditions 3/20/89)
- Selected other general and project specific documents

2. Interviews and Analysis. High-Point Schaer established an interview schedule commencing first with SCRTD and in advancing through the organizations of MRTC, PDCD and on a selective basis, general contractors. Where appropriate, interviews were directed to specific projects and/or features of the overall program. Interview forms were developed providing a basis for capturing all pertinent information discussed. Blank interview guideline forms are contained in Appendix A-3-1 and A-3-2, herein. The completed and hand written interview forms are contained in Appendix B herein.

In performing the assignment, the following individuals were interviewed:

SCRTD

- Friday, June 23 - SCRTD Kick-off Meeting: T.L. Johnson, Jeff Christiansen, Louisa Simpson, John Bilich, Norm Crawford and Paul Schneider
 - John Bilich: in a subsequent interview with Mr. Bilich, the interview scheduled for SCRTD, MRTC, and PDCD was established.

- Tuesday, June 27 - T.L. Johnson, SCRTD; Norm Crawford, SCRTD; Mr. Maddox, MRTC; Bill Marsh, SCRTD; the SCRTD Project Teams for A175, A187, A135, A136, A130.

- Wed., June 28 - Samuel Louis, SCRTD; Bob Seckler, Mr. Murthy, MRTC; the SCRTD Project Teams for A640, A710, A740, A745, A141, A147, A171, A610/115, A112.

- Thursday, June 19- James Crawley, SCRTD; Joel Sandberg, the SCRTD Project Teams for A650, A620, A616, A145, A157, A165, A167, A141, A146.

- Friday, June 30 - Mr. Polacek, PDCD.

- Monday, July 3 - --

- Tuesday, July 4 - Holiday
- Wed., July 5 - Alvaro Amandor, MRTC; Grady Cofer, MRTC; Rolland Cooper, MRTC; Mr. Johnson, MRTC.
- Thursday, July 6 - Bob Campbell, Bud Stote, Jerry Eide, Jeri Krug, Chuck Bionghi, Ron Anderson, Dickson Yao and Mike Hoffman, PDCD; addressing projects A135, A136, A175, A187, A141, A147, A145, A157, A165, A167, A130, A171, A610/115, A112, A141, A146 as well as estimating cost control and claims.
- Friday, July 7 - Tony Ferruccio, PDCD; A135. Dale Nyberg, PDCD, A112, A115, A610. John Paul Whyte, PDCD, A130.
- Monday, July 10 - Mike Lingenfelter, PDCD; Mike Cassagnol; G. D. Eyzaguirre, PDCD; Neal Johnson, PDCD; Peter Semrad, PDCD; A. L. Crowell, PDCD; Steve Navin, Don Nolson, PDCD.
- Tuesday, July 11 - Dan Riggs, PDCD; Bob Griffith, PDCD.
- Wed., July 12 - Close-out briefing, SCRTD, PDCD, MRTC.

3. Data Base. The High-Point Schaer database for the project estimate to complete analysis is developed to acquire comprehensive data from a number of sources. Inputs can be provided from:

- The SCRTD Estimate to Complete
- SCRTD Engineering Estimates
- Other claims analysis, from Lillick & McHose
- Other key SCRTD data elements or cost, schedule and actual expenditures
- Assessment values and inputs from the High-Point Schaer assessment

Supporting but not linked databases would include job estimates such as included in MOS-1 Revision 19, change order log and claims log.

This database is designed to first provide a reassessed estimate of the Metro Red Line Estimate to Complete. Secondly, with the inclusion of the PDCD and SCRTD assessment information reference and analysis can be made to their analysis. Additionally, the inclusion of Cost to Complete information and schedule data would provide the extension capability for cash flow analysis under the different schedule scenarios. Finally, there is provision to provide independent input values on claims for jobs.

The estimate database structure is identified in Appendix A-3-4 and the database spreadsheet, completed only for the reassessed estimate is included in Appendix A-3-5.

B. ASSESSMENT SCHEDULE

1. **Start up and Field Work, Guidelines and Data Acquisition.** High-Point Schaer's schedule of work was broken into 3 distinct areas:

- Week 1 Meet with SCRTD project teams on all projects and review and acquire, when necessary, all estimates, change orders, schedules and claims - both booked and anticipated. Since back-up material for the SCRTD spread sheets were not supplied to High-Point Schaer at the kick-off meeting, during the interview processes it became essential to acquire all back-up documentation in order to perform an in-depth analysis.
- Week 2 Meet with MRTC project teams to discuss in detail the status of design, by discipline of unawarded Stage II contracts and to discuss schedules for completion of drawings and specifications and targeted bidding dates. Interviewed PDCD office project teams and reviewed in detail the status of all projects with emphasis on schedule completion dates, change orders, booked and or anticipated claims and PDCD's evaluation of the Contractor's performance.
- Week 3 Meet at each field office with the PDCD resident Engineer and reviewed in detail the project status with particular focus on

Contractor's performance, known or potential delays, claims and schedule disruptions. On selected basis, meet with Contractor personnel with resident engineers to discuss contractor concerns.

2. **Analysis.** The High-Point Schaer team upon return to their home office conducted a systematic evaluation of each project to determine potential schedule delays, if any, and their impact upon final costs.

3. **Draft Presentation.** On July 21, Mr. Steve Davis and Mr. John Smith will deliver a draft report and make a verbal presentation to SCRTD on the High-Point Schaer findings.

4. **Final Report.** Upon receipt of SCRTD's comments on July 28, 1989, High-Point Schaer will conduct whatever additional reviews, interviews and assessments are necessary and will submit a final report to SCRTD on August ?, 1989.

IV. ASSESSMENT OF SCRTD'S ESTIMATE TO COMPLETE METHODOLOGY

A. OVERVIEW

The total budget for the Metro Rail Project has held at \$1.2499 billion in all Schedule and Financial Plans since Revision #5, September 1986. The budgetary actions are clearly identified in the Quarterly Budget Revisions, Series 5, Original through 5D; Series 6, Original through 6D and Series 7 Original.

Exhibit IV-1, Other and Construction Cost Trends, illustrates the trends associated with both of the cost components of the budget. The Other Cost Component has continued to increase growing from \$591 million in Revision 5, September 1986, to \$623 million in Revision 7, March of 1989. This \$32 million growth, some 5% plus, has been achieved through a corresponding reduction of funds for construction and procurement. The construction and procurement funds have been reduced from \$659 million, with Revision 5, September 1986, to \$627 million with Revision 7, March 1989.

The current Estimate to Complete reflects an increase in the Total Forecast to Complete. Two such estimates were provided at the start of the Verification of Estimate Assessment. One estimate represented PDCD and the other SCRTD. These two Estimates to Complete are summarized in Exhibit IV-2.A and B, Total Estimated Cost to Complete.

This section of the report reviews the basic methodology used to develop The Estimated Cost to Complete, concentrating principally on the SCRTD approach. Based on this review and assessment, comments are made on the quality of the

SCRTD Estimate to Complete data. The findings and assessment of the prepared Estimate to Complete leads to the requirement of reassessing the basic data and building up the estimate in order to factor out the biasing issues identified in this Section.

B. BASIC METHODOLOGY OF ESTIMATE TO COMPLETE

The SCRTD's Estimate to Complete was built on precedent budgeting and estimating practices. These practices were and are organized to permit an ongoing budgeting role in a dynamic program environment. Thus, methods of analysis, data development and forecasting have been developed to provide a comprehensive yet organized view of the budget needs of the project. These methods are integral to how the Estimate to Complete was formulated and how the values come about.

The SCRTD basic methodology to prepare The Estimate to Complete starts with previously developed data, data acquisition processes and budgetary practices. The total budget was divided into two major categories:

- Contracts, including all construction and procurement contracts, as well as the Master Agreements
- Other Costs

The Contracts were further divided into:

- Awarded Contracts

- Unawarded Contracts
- Master Agreements

The Other Costs divide into the several categories of consulting, the MRT agency costs, insurance and contingency.

With these basic categories, the awarded or total estimated values and executed change orders were brought together to represent a Current Value for each line item. Selected allowance factors were then applied to the Contract line items. These included assessment by both PDCD and SCRTD. The allowances factored into the Estimate to Complete included:

- The CCB Records for Potential Change Log and Schedule Revisions
- The Potential Claim Log
- Un-booked Changes and Claims
- The MRT/LRT Split of Funding

Exhibit IV-3, Estimated Cost to Complete, is the resultant SCRTD analysis. The total on page 3 is carried forward to Total Estimated Cost to Complete. This exhibit includes the awarded contracts, the unawarded jobs and the Master Agreements.

The Other Costs include a number of specific components, they are:

- Design - Related Professional Services Costs
- Construction Related Professional Services Costs
- Agency Costs
- General Consultant Costs
- Construction Manager Costs
- Right-Of-Way Costs
- OCIP - Insurance Costs
- Preliminary Engineering Costs
- Contingency Costs

Exhibit IV-4, Other Costs Forecast of June 1989, shows the costs associated with the Total Estimate to Complete. This is carried forward to the Total Estimate to Complete.

As shown in Exhibit IV-2, the Total Estimate to Complete totals the two components, deducts the expended to date, adds a 10% contingency for the expenditure remaining to the total of the two components. The result is a program

total of \$1.367 billion. Following right-of-way and dividend deductions of \$12 million, an overrun of \$104 million is shown over the current program budget of \$1.2499 billion. Exhibit IV-2B, Total Estimated Cost to Complete, illustrates the distribution of that current estimate.

C. ANALYSIS METHOD APPLIED TO ESTIMATE TO COMPLETE

The analysis method applied to reviewing the Estimate to Complete divides into assessing the individual cost categories. Each category is presented below:

1. Unawarded Contracts

a. Design Estimate

For unawarded contracts the Design Estimate shown in the Estimated Cost to Complete is a value per contract number developed from available information. This information varies from job to job and in timeliness. Additionally, it is subject to an escalation analysis. The result is that there is a varying pattern of funds availability.

An analysis of the unawarded contracts shows:

- A number of contracts' estimates are from 1985, yet a number are current, made in 1989.
- For a number of estimates made in 1989, contingency allowances were carried within the job estimate, as High-Point Schaer was advised by PDCD.

- The PDCD estimates are developed as mid-bidding range estimates. Additionally, these estimates are understood to be current, in preparation for bidding.
- Finally, the SCRTD budgeting practice takes engineers estimates, escalates backward to 1985 and then forward to the scheduled mid-point of the project. This practice apparently duplicates cost escalations by PDCD.

Thus, in extending the individual estimates through the escalation process used to set up the Design Estimate, a conservative carry forward and escalation of contingency is developed. Exhibit IV-5, Design Estimate Analysis, outlines the impact of the estimating methodology, which results in an included allowance of some \$6,750,000. It is important to note that the total of the unawarded work receives an additional 10% contingency at the end of the Total Estimate to Cost analysis. Thus, an allowance of \$7,984,383 is allotted to the unawarded work. The two allowances total some \$14,734,383 on a base estimate cost of \$73,091,346.05, a 20% contingency.

b. Schedule Revision

A Schedule Revision Analysis was carried out against the Revision 6 Estimates for the Unawarded Contracts. The Probable Case Summary ROD Extension Costs, Contract number values, Exhibit IV-6, do not correspond to the Total Estimate to Complete Unawarded Contracts, Exhibit IV-3 column E, Schedule Revision. In either case, it is

questionable if this allowance is necessary, given the method in which the estimates were developed.

The major dollar items in the Unawarded Contracts have been estimated based on the Revision 7 Schedule, and thus, should reflect in the original estimate, the escalation impact (the Revision 7 condition). Thus an additional \$1,229,000 allowance exists within the Unawarded Contracts because the Schedule Revision values have been added. Additionally, this value is adjusted downward by PDCD and SCRTD to \$1,030,000, for reasons not identified at this time but it also includes the final 10% contingency of \$103,000 at the end of the Estimate to Complete calculation. Thus the Schedule revision values total some \$1,133,000 in allowances:

c. Un-Booked Changes and Claims

Un-booked Changes and Claims are not supported by any specific priced scopes of work, but are allocations of funds. PDCD in their Change/Claims Exposure Analysis, provided allowance factors for this category

- A 5.0% allowance for finish work.
- An addition 1% to 1.5% allowance for interference and plan/specification deficiency.
- For system contracts only a 1.5% factor was used.

The PDCD total was \$3,902,000

SCRTD provided larger allowances in the case of Union Station and rounded off the higher numbers in the other contract numbers. The SCRTD total was \$5,775,000. This, again, rolls up into an additional 10%, or \$577,500 portion of the final contingency at the Total Estimate to Complete, providing a total allowance of \$6,352,500.

d. Summary of Allowance Within and Allocated to the Unawarded Contracts

Table IV-1, Summary of Unawarded Contract Allowances, shows a total allowance of \$22,219,883 on top of a hard estimate total of \$73,091,346. This essentially provides a contingency value of 30.4% on the hard estimate total. Exhibit IV-7, Allowances Associated with Unawarded Contracts shows the funds allocated to these contracts.

**TABLE IV-1
 SUMMARY OF UNAWARDED CONTRACT ALLOWANCE**

<u>Category</u> <u>Estimate Source</u>	Total added as included in <u>Unawarded</u> <u>Component</u>	Allowance part of total <u>Bottom Line</u> <u>Contingency</u>	Total associated with <u>Unawarded</u> <u>Contracts</u>
Design Estimate	\$ 6,750,000	\$7,985,383	\$14,734,383
Schedule Revisions	1,030,000	103,000	1,133,000
Un-Booked Changes and Claims	<u>5,775,000</u>	<u>577,500</u>	<u>6,352,500</u>
Totals:	\$13,555,000	\$8,665,883	\$22,217,883

Exhibit IV-7 illustrates the hard estimate portion of The Unawarded contracts at \$73,091,000. Additionally, it shows the allowance taken within the unawarded amount at \$13,555,000 and the unawarded contingency at \$8,666,883.

2. Awarded Contracts

a. Awarded Contracts, Executed Change Orders, Current Value and Expended To-Date

For awarded contracts the base data for the Total Estimate Cost to Complete is the summary of the contractual awards and executed change orders. This totals the current value of each contract. Additionally, it is important to note that some \$190,109,000 million has been expended, as reported in the May 1989 Status Report. It is important to note that the executed change orders include all unilaterally, SCRTD approved change orders.

b. Potential Change Log

The CCB Potential Change Log for May 30, 1989 totaled \$20,313,020. Both PDCD and SCRTD carried out assessments on this log reducing the values respectively to \$17,121,729 and \$20,185,904.

PDCD provided independent assessments on selected projects while concurring with the potential change log on others. SCRTD also provided independent assessment on selected projects while generally concurring throughout. Both PDCD and SCRTD did not include the \$1,000,000

reduction in A130 for the limit on the ground water treatment. Modest other adjustments were made to both PDCD and SCRTD assessment.

Thus, all outstanding potential changes are included in this listing. There may be potential changes without dollar values which could result in a dollar impact.

Exhibit IV-11, Application of MRT Factors removes the LRT portion from the Potential Change Log. The net result is a MRT potential change log of \$20,033,949. This impacts the final contingency in the Total Estimate to Complete by adding 10% or \$2,003,394, totaling \$22,037,343 associated with the Potential Change Log.

c. Schedule Revisions

As with the Unawarded Contracts a Schedule Revision Analysis by SCRTD was carried out to evaluate the impact of changing from Revision 6 Schedule to Revision 7 Schedule. This is an extensive analysis which totals \$21,678,000. Exhibit IV-6 provides the summary data for this analysis precedent to entry on the Estimated Cost to Complete Spreadsheets and supported by Exhibit IV-8, Project Schedule Evaluation Analysis and Assumptions, Exhibit IV-9, Case III Probable Schedule Analysis, and Exhibit IV-10, Explanation of Case III Probable Schedule Analysis.

This Schedule Revision Analysis was undertaken to reflect the change in schedule from Revision 6 to Revision 7. High-Point Schaer noted the following:

- First, as illustrated with Contract A640, the schedule change from Revision 6 to Revision 7 will, in the opinion of the Project Engineer and Resident Engineer, reduce the Potential Change Log and not require the allocation for Schedule Reserve, as the schedule change would return the program to its original elapsed time. This impact could exist elsewhere.
- Second, there is no procedural or analysis approach which directly correlates the Schedule Revision line items, scope and value to the Potential Change Log, Potential Claims, Un-booked Changes and Claims, or the total contingency. Therefore, this funding category could be duplicating other allocations.

Thus, the Schedule Revision value is an allowance over and above all Potential Change Log items, Claims, and Un-booked Changes and Claims and could duplicate specified items of the latter two.

Exhibit IV-11 shows Schedule Revisions applicable to MRT totaling \$21,409,420. Additionally, the total contingency will carry a 10% allocation of 2,409,269 totaling \$23,550,659.

d. Assessment of Claims

Both PDCD and SCRTD assessed the Potential Claims of the Claims log. The PDCD value is based on their individual claim estimates totaled by

contract. The SCRTD value is a determination of judgement based on knowledge of the claims and other outstanding features associated with the claim.

The total value shown for SCRTD is \$14,758,366, which, as shown is Exhibit IV-11, reduces to \$14,742,366 upon applying the MRT factor. Additionally, the carry-forward to the Total Estimated Cost to Complete results in an additional 10% contingency component of \$1,742,436, resulting in a Total Allowance Value of \$16,216,602.

Note: These values do not include the omitted SCRTD's assessment for claims, column N, for contract A165. Thus these values, as well as, the total could increase.

e. Un-Booked Changes and Claims

PDCD based its un-booked changes and claims on exposure factors applied to the balance to finish portions of the individual projects. The exposure factors ranged from 2.0% to 8.9% for construction. No exposure was taken on the procurement contracts.

SCRTD utilized the PDCD analysis and defined selected critical items for specific contracts, including the procurement contracts. The un-booked changes and claims for SCRTD totaled \$22,400,000 of which, as shown on Exhibit IV-11, applies \$22,237,000 to MRT. Additionally, a 10% contingency associated with this number is carried with the Total Estimated Cost to Complete. This contingency of \$2,223,700 added to the Un-Booked Changes and Claims results in a total of \$24,460,700.

f. Summary of Contract Expenditures, And of Allowances Within And Allocated to Contracts

As of the end of May 1989 the amount expended on MRT contracts totaled \$190,109,000. Table IV-2, Summary of Awarded Contract Allowances, shows a Total Allowance associated with Potential Changes, Schedule Revisions, Claims and Un-Booked Changes and Claims totaling \$78,423,005, with it contributing an additional \$7,421,799 to the total contingency and summing for contracts to \$86,265,304.

**TABLE IV-2
 SUMMARY OF AWARDED CONTRACT ALLOWANCE**

<u>Category of Item</u>	<u>Included in Contract Category</u>	<u>Added as part of total Bottom Line Contingency</u>	<u>Total Allowance Associated with Awarded Contracts</u>
Potential Change	\$20,033,949	\$2,003,394	\$22,037,343
Schedule Revisions	21,409,690	2,140,969	23,550,659
Claims	14,742,366	1,474,236	16,216,602
Un-booked Changes and Claims	<u>22,237,000</u>	<u>2,223,700</u>	<u>24,460,700</u>
	<u>\$78,423,005</u>	<u>\$7,842,199</u>	<u>\$86,265,304</u>

These values are graphically illustrated in Exhibit IV-12, Allowances Associated with Awarded Contracts. Additionally, the value for Awarded Contracts to Complete is stated as \$303,785,000 and the roll up of the allowances for contingency is shown at \$7,842,199.

3. **Master Agreements.** The Master Agreements are the agreements arranged with municipalities, utilities, and others who will be affected by the program work. Exhibit IV-13, Master Agreement Status lists the Master Agreements from the Estimate to Complete, the slightly different values found in the May Monthly Report and the expenditure to date at the end of May.

No adjustments are made in the Estimate to Complete for potential changes, schedule revisions, claims, or un-booked changes or claims. Only the proration between MRT and LRT is applied to the Master Agreements.

As shown in Exhibit IV-13, \$4,059,731 of the MRT values has been expended, some 24% of the Estimate to Complete Total, for the Master Agreements. Granting interview observations of slow invoicing of Master Agreement work, the assumption could be made that sufficient funds are available since there is only 25% expended at this time in the project.

Based on the method of calculating the Total Estimate to Complete value the unexpended portion of the Master Agreements carries a 10% contingency. This value would be 10% of \$16,592,550 less \$4,059,731 or \$1,253,282. Exhibit IV-14, Allowances Associated with Master Agreements, illustrates the expended portion of the Master Agreements and the impact on contingency.

4. **Other Costs.** The Other Costs include:

- General Consultant
- Construction Manager
- Construction Related Professional Services
- Design Related Professional Services

- Agency
- Right of Way
- OCIP (Insurance)
- Preliminary Engineering
- A Contingency Value

Exhibit IV-15 lists all the Other Costs as applied to the Total Estimate to Complete. Of the Total Estimate to Complete of \$602,811,000 the amount of \$443,101,000 has been expended, based on the March 31, 1989 Schedule and Financial Plan cash flow through June 30, 1989. Thus some \$159,710,000 is the balance to complete before any contingency value as shown in Exhibit IV-15.

Exhibit IV-16 adds the expended and to complete data for Other Costs to the overall pie chart.

D. QUALITY OF ESTIMATE TO COMPLETE

The quality of the Estimate to Complete is a function of how allowances and contingencies are applied and integrated into a total. The SCRTD provided Estimate to Complete, Exhibit IV-2, is a conservative estimate which combines all allowances and contingencies and then adds a final 10% to the total cost to complete beyond costs expended.

1. **Revision - 1, Estimate to Complete.** A more rigorous approach would be to remove the allowances built in to the cost to complete prior to applying the bottom line contingency. This includes removing:

- Contingencies and escalations for Unawarded Contracts.
- Allowances for potential changes for Awarded Contracts.
- Allowances for claims for Awarded Contracts.
- Allowances for Un-Booked Changes and Claims.

Exhibit IV-17, Revision 1, Estimate to Complete, applies this allowance reduction and then takes 10% of the remaining values that is to be expended and then adds back in the above allowances. The resultant overrun is \$95,656,107.

2. **Revision 2, Estimate to Complete.** Further refining the Estimate to Complete by selectively applying contingency to construction and Other Costs only further reduces the overrun. Exhibit IV-18 Revision 2, Estimate to Complete shows an overrun of \$86,418,106 where the contingency on other cost has been reduced from 10% to 5% reflecting the status of the program.

3. **Revision 3, Estimate to Complete.** A more rigorous analysis further applies additional values for expended to date and appear in Revision 3, and Exhibit IV-19-1 to 19-3. By discretely breaking out the data on expended to date, on allowances, on contracts to complete, and by applying discrete contingency values to the several categories of cost the overrun could be shown as \$63,144,930.

The basic question of assessment is: What is the quality of the values associated with the Estimate to Complete costing categories; is there redundancy; and can the values be justified? The next Section reviews these features of the Estimate to Complete.

V. REASSESSMENT OF ESTIMATE TO COMPLETE

A. OVERVIEW

Integral with the fact findings and analysis of the SCRTD Estimate to Complete, is the fact finding on the project status, and cost projections. This work included assessment of potential change orders, schedule revisions issues, claims and un-booked change orders and claims. Additionally, the overall schedule status and progress of each project was assessed.

The objective of these fact finding assessments was to obtain the basis for reassessing the Estimate to Complete, if needed. As the overall fact finding progressed, it became evident that the SCRTD prepared Estimate to Complete, through demonstrating a reasonable budgetary approach, included a number of noteworthy characteristics.

- The schedule used for the budget was found to not completely reflect the actual progress of projects in all cases
- The mathematical approach on taking contingencies and rolling up contingencies and allowances for schedule revisions appeared conservative
- The use of allowance values without specific supporting issues was identified
- Items identified as necessary but not included in the budget were taken into account

In order to assess the Estimate to Complete it was judged necessary to reassess the basic build up of the Estimate.

First, the schedule was reviewed to assess the overall impact of the current status of the program. Following the reassessment of individual project, where the current status and forecastable status based on current demonstrated progress was taken into account, a resultant overall schedule was developed.

With this schedule as the guideline for reassessment, costs on each individual major job was reassessed, as were the Master Agreements. The other costs were reassessed in terms of the schedule developed to reflect the current status of the project. From these estimates the reassessed estimate was built up to reflect the findings uncovered in the analysis of individual job information and findings on the projects. The build up of the estimate was designed to provide a hard identifiable scope of assessments of cost. Allowances and contingencies would be identified and only included in job line items where line item requirements could be identified.

For the purposes of comparison, the Final Total Estimate to Complete would be determined using SCRTD's approach on the total contingency. Additionally, the High-Point Schaer reassessment would redetermine the total Estimated Cost to Complete with selective revisions to contingencies applied:

- For unawarded contracts, a 10% contingency
- For awarded contracts, a 5% contingency

- For Master Agreements, 0% contingency
- For other costs, a 2% contingencies

The balance of this section reviews the basic methodology used to reassess the SCRTD estimate. The reassessment project schedule is reviewed. Both direct costs and other costs are reassessed. Finally, the recast Total Estimate to Complete is prepared in both the SCRTD form and an alternate form utilizing the above revised contingency amounts.

B. PROJECTED SCHEDULE TO COMPLETE

1. **Current Target Schedule.** The current target schedule is based on the probable schedule of revision 7. The two key elements in its preparation were the inclusion of a three month contingency period in stage two between stage two work and follow-on systems work and between track installation and tunnel system work. Exhibit V-1, Probable Schedule, Revision 7, with actuals, represents this target schedule.

2. **Optimistic Assessment Schedule.** The reassessment of the schedule results in a number of important shifts and one major shift in schedule. These reassessments were based on:

- An assessment of the current status and progress of projects. Particular attention was paid to the percent complete of a project and its percent ahead or behind the planned cumulative. The progress trend of each contract was examined.

- The review of the individual project status with the SCRTD Project Engineers and PDCD Resident Engineers.
- The probing challenge of how the behind schedule work will be recaptured.
- The availability of time and data to thoroughly and adequately research each individual job.

Two key factors clearly stand out in the reassessment.

- All station and tunnel contracts, but one, are behind schedule.
- One is significantly behind schedule.

Exhibit V-2, High-Point Schaer Optimistic Assessment illustrates the first schedule assessment. This assessment essentially states that the three month contingency built into the most probable schedule has been used up in the slippages occurring to date. Additionally, it assumes that the key delinquent project immediately achieve its planned level of progress and that there is no ripple impact on the systems construction, nor on the other contractor mode of operation and progress.

The resultant schedule shows that the three month contingency is exhausted. However, it indicates that the start of Pre-Revenue operations could start on schedule.

3. Probable Assessment. Using the same reassessment basis, a Probable Assessment schedule was prepared. This is illustrated in Exhibit V-3, High-Point Schaer's Probable Assessment.

The key impacting features on this schedule are as follows:

a. The A145 Project Impact.

The A145 project, with Guy F. Atkinson, is shown to be 21.3% behind schedule at the end of May, 1989. Their recent monthly slippage has been of the order of a negative three to five percent. The June progress commented on in the field visits indicates no change in progress should be expected. Thus, their planned progress will not be achieved nor will the percent behind be reduced. Conversely, the percent behind conditions is expected to grow to the order of 25% behind at the end of June.

Should the A145 contract be able to achieve a reasonable level of progress immediately, of say 4.0% per month, around three times his current progress, he would still be six months behind schedule. This immediate response is not likely.

A more likely response is a gradual change, a recovery plan implementation or a replacement contractor. Under these scenarios, the delay could be expected to take up to a year.

The result is an anticipated shift in completion of job A145 and a shift of access availability of up to one year. High-Point Schaer found that in no

interview, document, meeting or review, had any plan, action program or contractor initiative been found to alter the present progress. Thus, the High-Point Schaer assessment is that, using a traditional and sound construction industry forecasting philosophy, the lost progress will not be made up and the job deferred, based on current progress. Should sound evidence to the contrary be presented this reassessment can be altered.

b. Direct Impact of A145.

The time limitations of this assessment is too limited to thoroughly assess the A145 project or its impacts throughout the project. However, certain basic observations are drawn:

- The delays in A145 will impact the tunnel work associated with the station, specifically A141 and A146. This will delay at least the track work in those tunnels and associated with station A145.
- The main rail laying plan will be delayed because of the delay in completing the tunnels around and in A145.
- The combination of those delays will impact the systems work in those tunnel and station location.

c. Indirect Ripple Impact.

There is the consideration herein, for the impacts, if any exist, of the progress status and approach with the A145 contractor rippling to other contractors. This could take a number of forms in:

- Other contractors falling behind
- Influx of delay based claims
- Complexities in bidding Stage II work

These issues, and others, will tend to further exasperate the project.

d. Probable Schedule Impacts.

Thus, High-Point Schaer, used as a basis of their reassessment a nine month extended schedule. This extension will be placed as a continuation of the 1991-1992 level of effort within the project.

Direct Costs; awarded contracts, unawarded contracts and Master Agreements were analyzed based on their known scopes. Other costs were analyzed on the basis of an additional nine months during the overall program of the project. Contingencies were applied both as SCRTD applied them in their Total Estimate to Complete and selectively as previously described. While the need for funds for claims and litigation will be noted at the conclusion of the analysis, their inclusion as part of the construction contingency will be held as a separate evaluation.

C. DIRECT WORK ASSESSMENT

The assessment of direct work was carried out through a comprehensive process, limited by the time available. It included:

- Field interviews and document research
- Analysis of the estimating process used to derive the estimate values for unawarded work
- Assessment of the potential claims for each project
- Assessment of the overall schedule revision process and an independent interpretation of their application and correlation to other funding categories
- Assessment of the claims for High-Point Schaer's understanding, but used in the completed analysis of the total claim value to date
- Assessment of the un-booked changes and claims and the inclusion of independently identified cost item

The job by job analysis is provided in summary in the Job Analysis Sheets in Appendix A-3-2. These summarize the findings and analysis applied to each project to determine the High-Point Schaer assessment values at this time.

The detailed analysis was prepared on a spreadsheet basis. The spreadsheet database design is described in Appendix A-3-4 and the actual spreadsheet analysis is shown in Appendix A-3.6. The following sections outline the basis for analysis.

1. **Estimate Costs.** All estimated costs for unawarded contracts were accepted as provided. However, the extent of allowances and contingencies included by providing a contingency factor in the engineers' estimate and escalating the cost to the mid-point of the project, was determined and retained as a separate record for possible future deduction.

A methodology is needed to provide real dollar estimates for jobs where early estimates are made and their time of expenditure is in the future. This can be seriously questioned however, when essentially completed drawings are given a mid range bid estimate with contingency. Though no values were taken out of the High-Point Schaer analysis, all values for the escalation and contingency differential were determined by job and separately tabulated as part of a line item contingency.

2. **Potential Changes.** The potential changes were reviewed by job. The High-Point Schaer assessment resulted in concurring, on a job by job basis with one of the offered values, the CCB, the PDCD, or the SCRTD value, based on the individual job review.

3. **Schedule Review.** On a job by job basis, each individual Schedule Revision value was assessed to determine if it could be redundant with either claims, PDCD and/or SCRTD identified Un-Booked Changes or Claims or High-Point Schaer identified additionally uncovered items.

In the time available, this preliminary review provided a rigorous screening of redundancy and scope coverage where there was evidence that the Schedule Revision value was reiterating another value in Potential Changes, or un-booked changes or claims. In such case the value was reduced or eliminated. The remaining reduced value for a Schedule Revision may have included scope changes as well as schedule related requirements, as that is how the analysis was structured. Though the values were retained as a schedule related item, that value being separately tabulated as a line item contingency. As identified, other contingency needs were also noted.

4. Potential Claims. Potential claims were retained as full value claim items. The database allocated additional space for notation by job number. Additionally, High-Point Schaer provided a preliminary observation on the merit level of the claims by job. The analysis database will provide entry of other assessments, remarks as well as a High-Point Schaer assessment value if further analysis of specific claims is to be undertaken.

Only the total potential claim value is entered into the High-Point Schaer assessment analysis formalization.

5. Un-Booked Changes and Claims. Un-Booked Changes and Claims represent the aggregating of the analysis by PDCD in determining values, the SCRTD developed values and the resultant line item observations by High-Point Schaer on stated funding needs not covered by other categories. Specific line item allocations were sought rather than flat contingencies.

The PDCD analysis was basically a contingency percentage against the unexpended portion of contracts, a lower level for the procurements and an allowance percentage for the unawarded contracts. SCRTD's listing was a concurrence with PDCD, rounding of values or the addition of general contingency values.

High-Point Schaer developed the Un-Booked Changes and Claims by evaluating the above products and assessing claims mentioned issues as well as identifying additional funding needs. As time permitted, such items as unilateral change orders, denied change orders, reject claims and zero dollar claims were acknowledged and allowances made. Clearly, there is extensive additional work needed to thoroughly review and reconcile the issues associated with Un-Booked Changes and Claims as covered by the several categories of items.

6. Contingency, By Line Item. Contingency by line item was identified to reflect the estimate contingency and escalation, as well as schedule reserve value calculated within a job.

7. Master Agreements, a Specific Case. Though the database analysis for Master Agreements is the same as that for awarded and unawarded contracts, the unique status results in a limited line item analysis. None of the adjustment factors apply in the estimate reassessment.

The principal evaluative criteria is that only in the order of 25% of the budgeted funds to date have been expended. The 75% remaining funds are taken as sufficient to complete the project and therefore, reduces the need for a full 10% contingency.

8. Impact Of Schedule. For the direct cost analysis, as related to the nine month schedule delay, no additional estimated costs are included. At this stage of analysis, the basis is that the contractors will continue to extend their work, but at a level that will not reduce the Other Costs. The contractor extension will be at their election and though they may claim delay, no merit is presently considered. Nor are any litigation award values included beyond that addressed elsewhere.

D. OTHER COSTS

The other cost categories divide into:

- General Consultant
- Construction Manager
- Agency
- Design Related Professional Services
- Construction Related Professional Services
- Right-of-Way
- OCIP
- Preliminary Engineering
- Contingency

1. **General Consultant.** The General Consultant funding requirement has been reassessed based on three features:

- The extended nine month period as a period of 1992, 1993
- The absence of sufficient funds in 1989-90 for MRTC, principally for construction support. This appears to be a deficiency in the available forecast
- The historic under estimating of MRTC budget needs

Additional funding of \$5,000,000 has been determined necessary for the General Consultancy based upon the above features. See Exhibit (future inclusion).

2. Construction Manager. The Construction Manager funding requirement has been reassessed based on:

- The extended nine month period as of the period 1992-1993
- Their historic trend of generally meeting their funding target or bettering their funding target.

Thus the Construction Managers additional funding, though \$12,000,000, as a block insert in 1991, 1992.

3. Agency. The SCRTD Agency funding requirement is predicated on:

- The extended nine month period as the period of 1991, 1992
- Selective adjustments to each department in the Agency program

The SCRTD manpower and budget analysis database was utilized to model the extended time period. The result was an increase value of \$8,214,000 for Agency.

4. Design Related Professional Services. No changes were made to Design Related Professional Services as the item was closed out.

5. Construction Related Professional Services. This other cost item was provided an allowance increase of \$2,000,000 to reflect the nine month extended schedule.

6. Balance Of Other Cost Items. The balance of the Other Cost items were not increased in funding requirements. These items include:

- Right-of-Way, could be subject to increase
- OCIP, could be subject to increase
- Preliminary engineering, which is closed
- Contingency which is to be taken as on final addition

E. TOTAL REASSESSED ESTIMATE

The detailed analysis possible to carry out in the limited time allocated to the assessment are contained in designated sections of the Appendix. These include the database designs, the database spreadsheet, the interview, narrative and analysis notes which support the database spreadsheet.

The resultant total reassessed estimates extract numbers from the database to determine the Reassessed Estimate to Complete.

1. Revision 4 - Estimate to Complete. This revision utilizes the High-Point Schaer reassessed project estimate values, as compared with the PDCD and SCRTD values. It applies the same analytical steps as carried out by SCRTD. The final calculation extracts line item contingency associated with unawarded contracts.

6. **Balance Of Other Cost Items.** The balance of the Other Cost items were not increased in funding requirements. These items include:

- Right-of-Way, could be subject to increase
- OCIP, could be subject to increase
- Preliminary engineering, which is closed
- Contingency which is to be taken as on final addition

E. TOTAL REASSESSED ESTIMATE

The detailed analysis possible to carry out in the limited time allocated to the assessment are contained in designated sections of the Appendix. These include the database designs, the database spreadsheet, the interview, narrative and analysis notes which support the database spreadsheet.

The resultant total reassessed estimates extract numbers from the database to determine the Reassessed Estimate to Complete.

1. **Revision 4 - Estimate to Complete.** This revision utilizes the High-Point Schaer reassessed project estimate values, as compared with the PDCD and SCRTD values. It applies the same analytical steps as carried out by SCRTD. The final calculation extracts line item contingency associated with unawarded contracts.

The resultant adjusted overrun is \$102,413,126 generally confirms the District's Estimate to Complete Overrun. Included is an allowance of \$14,820,761 which when removed, results in an overrun of \$87,592,465, as shown in Exhibit V-4, Revision 3, Estimate to Complete. This value includes the full allocation of claims funds booked to June 1, 1989.

2. Revision 5 - Estimate to Complete. This revision, as shown in Exhibit V-5.1, Revision 4, Estimate to Complete, carries out a more rigorous application of contingency based on tight, but realistic construction contingencies were calculated based on:

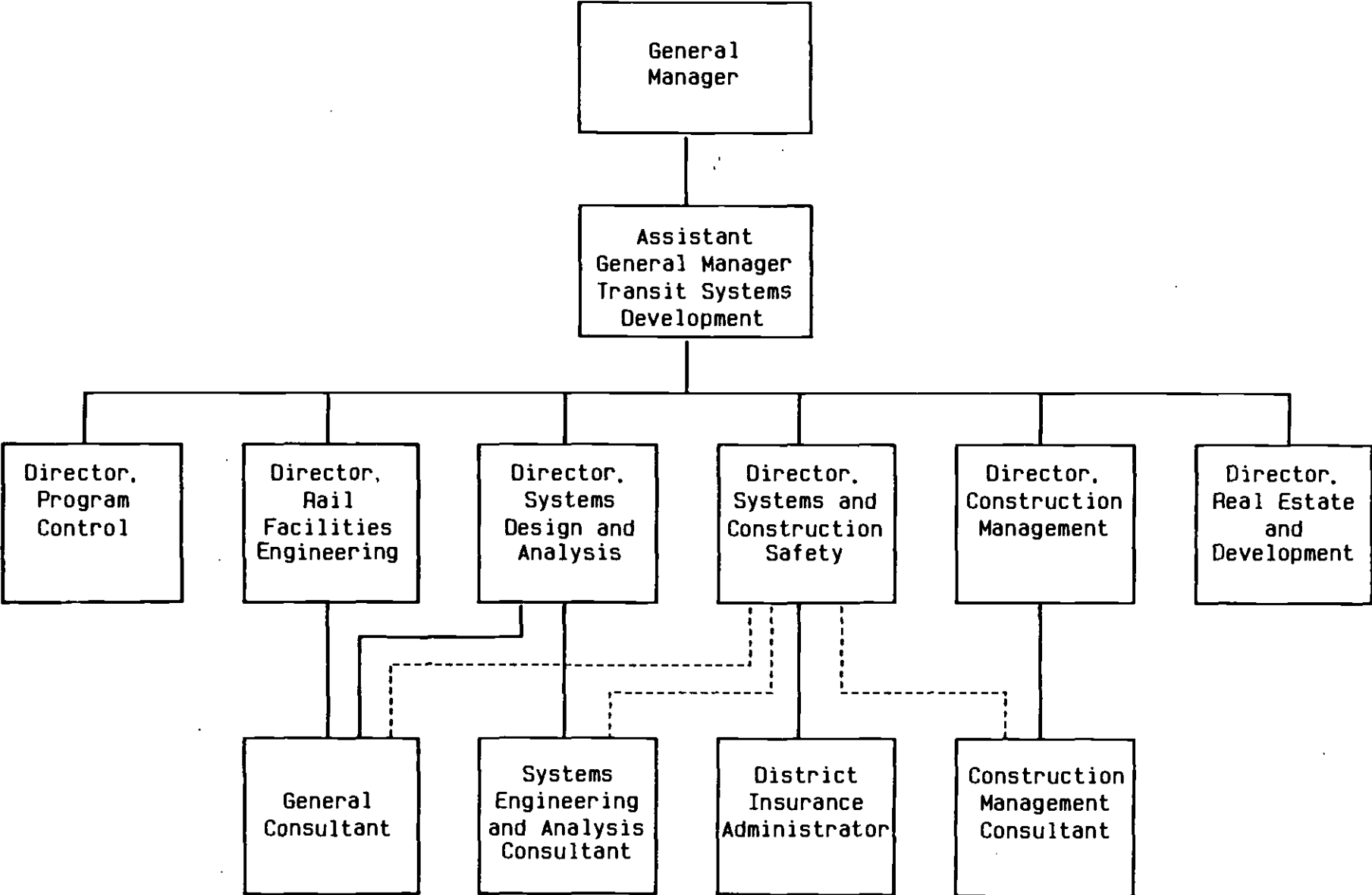
- 5% for outstanding underway construction
- 10% for unawarded construction
- No value for Master Agreement
- 2% for Other Costs

The resultant contingency allowance, as shown on Exhibit V-5.2 applied to the total costs result in an overrun of \$59,850,129. This amount contains the full allocation of claims funds booked to June 1, 1989.

3. Additional Assessment Considerations. Both Revision 4 and Revision 5, Estimates to Complete are considered in differing methods, to be tight but realistic estimate of total project cost. Routine and acceptable practices for assembling estimates and applying contingencies were incorporated. Additionally, the claims

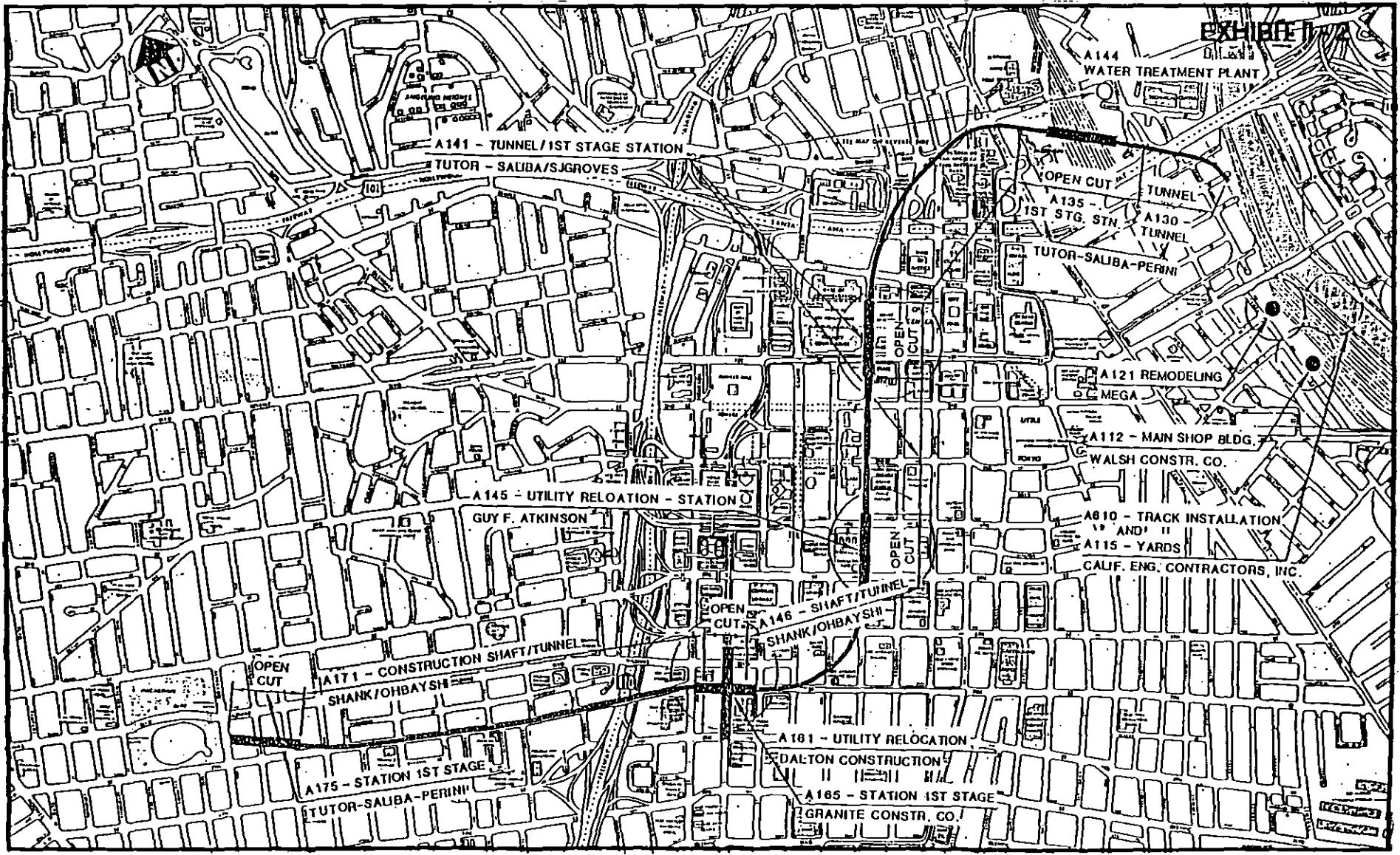
with costs are included at full value in this analysis. However, it is important to note that no claim reserves, claims funding, litigation costs or litigated claims payments are attempted at this time except to the extent provided in allowances and bottom line contingencies. Should funding requirements call for the inclusion of such funds, appropriate funding levels need to be determined.

EXHIBIT II-1
METRO RAIL CORE PROJECT TEAM



NOTE: Dashed line (-----) denotes support relationship.

EXHIBIT



A141 - TUNNEL / 1ST STAGE STATION

TUTOR - SALIBA/SJGROVES

A144
WATER TREATMENT PLANT

OPEN CUT
A135 -
1ST STG. STN

TUNNEL

A130 -
TUNNEL

TUTOR-SALIBA-PERINI

A121 REMODELING
MEGA

A112 - MAIN SHOP BLDG.

WALSH CONSTR. CO.

A810 - TRACK INSTALLATION
AND 11

A115 - YARDS

CALIF. ENG. CONTRACTORS, INC.

A145 - UTILITY RELOCATION - STATION

GUY F. ATKINSON

OPEN
CUT

A146 - SHAFT/TUNNEL

SHANK/OH BAYSH

OPEN
CUT

A171 - CONSTRUCTION SHAFT/TUNNEL

SHANK/OH BAYSH

A175 - STATION 1ST STAGE

TUTOR-SALIBA-PERINI

A161 - UTILITY RELOCATION

DALTON CONSTRUCTION

A165 - STATION 1ST STAGE

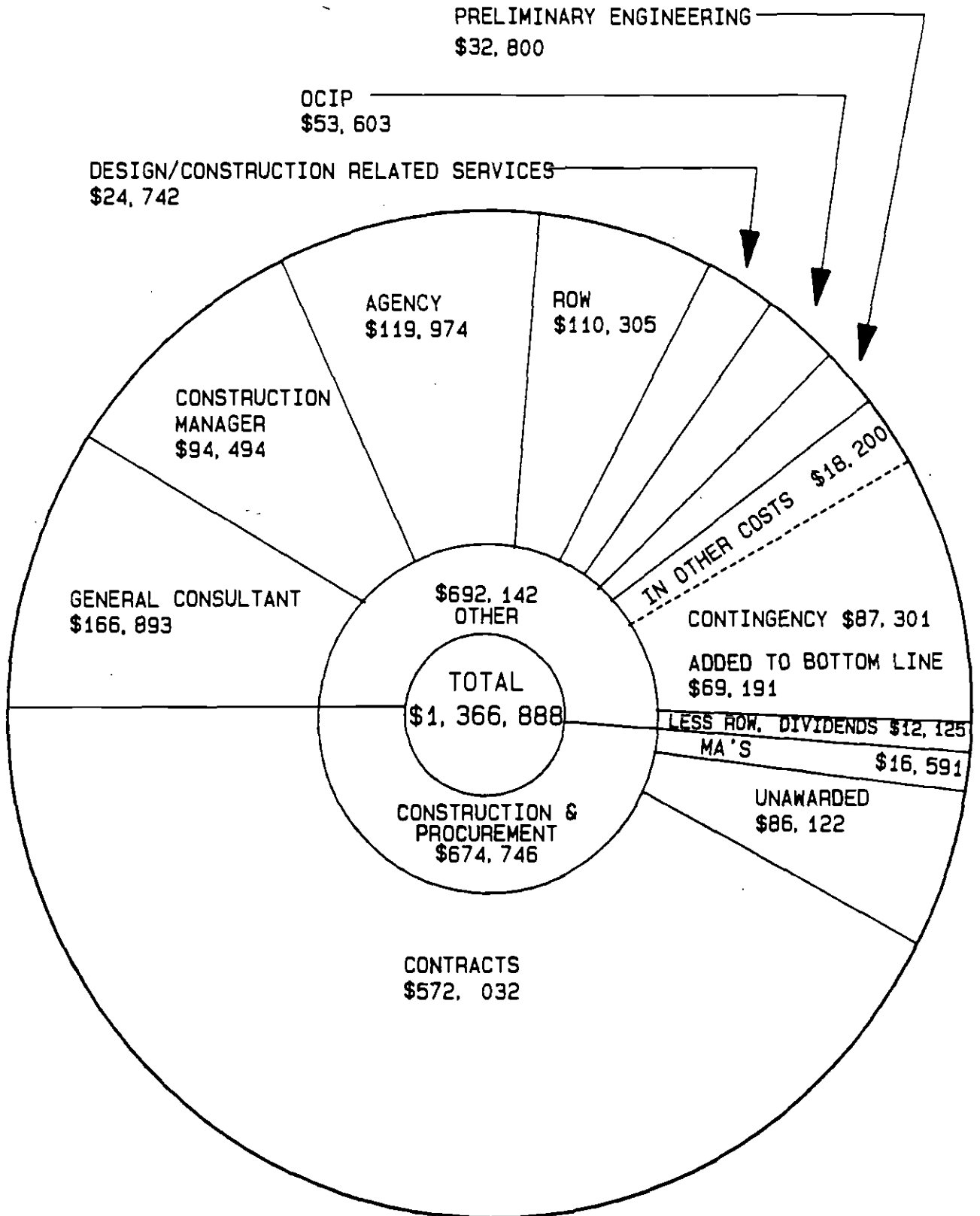
GRANITE CONSTR. CO.

Exhibit IV-2A
 Total Estimated Cost to Complete
 Southern California Rapid Transit District

	PDCD	SCRTD
	-----	-----
Admin, & Indirect	\$622,951,000	\$622,951,000
Direct Costs	\$650,266,328	\$674,745,773
	-----	-----
Subtotal Cost to Complete	\$1,273,217,328	\$1,297,696,773
Sub-total Cost to Complete	\$1,273,217,328	\$1,297,696,773
Less - Expend. to Date	(\$605,790,000)	(\$605,790,000)
	-----	-----
Expend. Remaining	\$667,427,328	\$691,906,773
Sub-total Cost to Complete	\$1,273,217,328	\$1,297,696,773
Add 10% Contingency	\$66,742,733	\$69,190,677
	-----	-----
Total Forecast to Complete	\$1,339,960,061	\$1,366,887,450
Less Original Budget	(\$1,249,900,000)	(\$1,249,900,000)
	-----	-----
Overrun	\$90,060,061	\$116,987,450
Less Row	(\$6,624,943)	(\$6,624,943)
Less Dividend	(\$5,500,000)	(\$5,500,000)
	-----	-----
Adjusted Overrun	\$77,935,118	\$104,862,507
	=====	=====

Source: MRT Program Control, June 23, 1989

EXHIBIT IV-2B
 TOTAL ESTIMATED COST TO COMPLETE
 PIE CHART
 SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT



UNMODIFIED CONTRACT#	0	1	010-C		010-I		010-J		010-L	010-M		010-N		010-O		010-P		010-Q		010-R		010-S		010-T		
			NETWQ	EXECUTED CAP	CURRENT YTD	CCO POCENTIAL CHANGE LHM	SCHEDULES REVISIONS	CCO CHANGE LHM		SCHEDULES REVISIONS	POCQ TOTAL	CCO POTENTIAL CHANGE LHM	SCHEDULES REVISIONS	POCQ TOTAL	CCO POTENTIAL CHANGE LHM	SCHEDULES REVISIONS	POCQ TOTAL	CCO POTENTIAL CHANGE LHM	SCHEDULES REVISIONS	POCQ TOTAL	CCO POTENTIAL CHANGE LHM	SCHEDULES REVISIONS	POCQ TOTAL	CCO POTENTIAL CHANGE LHM	SCHEDULES REVISIONS	POCQ TOTAL
0533 SANTA FE JWC REVISIONS	171,000	0	171,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0614 TAND TIRE POCING	375,764	0	375,764	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0213 TAND TIRE SIGHTING	164,000	0	164,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0143 TAND TIRE LANDSCAPING	445,000	0	445,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0326 BUCKINGHAM/CAROLINA TIR. AIRWAY	41,000	0	41,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0426 WESCO SYSTEMS, STAGE II	15,119,171	1	15,119,171	0	264,000	264,000	264,000	164,000	164,000	264,000	264,000	164,000	164,000	264,000	264,000	264,000	264,000	264,000	264,000	264,000	264,000	264,000	264,000	264,000	264,000	264,000
0608 WESCO SYSTEMS AIRWAYS	4,113,000	0	4,113,000	0	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
0329 WESCO SYSTEMS LANDSCAPING	1,216,000	0	1,216,000	0	200,000	200,000	200,000	1,000	1,000	200,000	200,000	1,000	1,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
0114 CYRUS CENTER TIR, STAGE II	13,214,000	0	13,214,000	0	311,000	311,000	311,000	111,000	111,000	311,000	311,000	111,000	111,000	311,000	311,000	311,000	311,000	311,000	311,000	311,000	311,000	311,000	311,000	311,000	311,000	311,000
0157 STRIPPER TIR, STAGE II	11,241,000	0	11,241,000	0	323,000	323,000	323,000	133,000	133,000	323,000	323,000	133,000	133,000	323,000	323,000	323,000	323,000	323,000	323,000	323,000	323,000	323,000	323,000	323,000	323,000	323,000
0425 WY/MSD TIR AIRWAY	624,000	0	624,000	0	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000
0206 WY/MSD TIR LANDSCAPING	111,000	0	111,000	0	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
0237 WY/MSD TIR, STAGE II	15,271,171	1	15,271,171	0	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000	164,000
0635 TRANSPORTATION TEST CENTER	629,000	0	629,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0675 LOGANVILLE PROCURE (MILK)	369,000	0	369,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0679 FLYE CAR PROCUREMENT	11,000	0	11,000	0	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000
0679 CHASE PROCUREMENT	35,000	0	35,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0680 OPERATIONAL SERVICES PROCURE	115,000	0	115,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0230 FLYE CARP EQUIP-PROCURE/LEASE	30,000	0	30,000	0	1,000	1,000	1,000	0	0	1,000	1,000	0	0	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
0225 FREE CARP CARP EQUIP PROCURE	151,000	0	151,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0240 BROWNS/CONCRETE	1,294,000	0	1,294,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0176 HUNTER-CORNER WHEELS PROCURE	300,000	0	300,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0175 HUNTER-CORNER WHEELS PROCURE	300,000	0	300,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0160 FORTITUDE PROCURE	111,000	0	111,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0205 FINE SUPPRESS EQUIP PROCURE	11,000	0	11,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0190 ICF STORES/CONCRETE PROCURE	130,000	0	130,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0191 ICF-20-TRANSIT	344,000	0	344,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	15,171,111	0	15,171,111	0	3,171,000	3,171,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000	1,130,000

FINANCIAL DATA ENTRANCE

EXHIBIT IV-4
OTHER COST FORECASTS OF JUNE 1989
SOUTHERN CALIFORNIA
RAPID TRANSIT DISTRICT

FORECAST WORKSHEET

OTHER COSTS FORECAST OF JUNE 1989

SHEET 1 OF 2

DATE: JUNE 21, 1989

OTHER COST DESCRIPTION	REV 6C EXTENDED THRU FY '89	REV 6C FORECAST THRU '92	TOTAL REV 6C OTHER COSTS	OTHER COSTS FORECAST MARCH 1989	OTHER COSTS FORECAST JUNE 1989	TOTAL FORECAST THROUGH JUNE 1989	VARIANCE REV 6C TO JUNE 1989	COMMENTS
DESIGN-RELATED PROFESSIONAL SERVICES	\$12,763	80	\$12,843	\$12,928	80	\$12,928	\$85	'85 TSD RE-ESTIMATE OF DESIGN RELATED SERVICES
CONSTRUCTION-RELATED PROFESSIONAL SERVICES	\$1,670	\$10,444	\$12,114	\$11,814	80	\$11,814	(\$300)	'85 TSD RE-ESTIMATE OF CONSTRUCTION-RELATED SERVICES
AGENCY COSTS	\$47,010	\$69,761	\$116,771	\$119,974	80	\$119,974	\$3,203	'85 TSD RE-ESTIMATE \$797,000; '82 TSD RE-ESTIMATE \$2,406,000
GENERAL CONSULTANT	\$144,062	\$15,933	\$159,995	\$165,893	\$1,000	\$166,893	\$6,898	'85 INCLUDED BILTM: \$359,100 IN ROD EXTENSION (P.15) '87 '90 MRC AMP NEGOTIATED \$4,878,000 '87 '91 TSD ENGINEERING RE-ESTIMATE \$1,020,000 '87 '92 TSD ENGINEERING RE-ESTIMATE \$1,000,000

OTHER COSTS FORECAST (CONT.)

OTHER COST DESCRIPTION	FY '88 EXPENDED	FY '89 REV AC FORECAST	TOTAL REV AC OTHER COSTS	OTHER COSTS FORECAST MARCH 1989	OTHER COSTS FORECAST JUNE 1989	TOTAL FORECAST THROUGH JUNE 1989	VARIANCE REV AC TO JUNE 1989	COMMENTS
CONSTRUCTION MANAGER	\$30,291	\$49,644	\$79,935	\$94,494	\$0	\$94,494	14,559	(1) INCLUDED BELOW: \$197,000 (IN ROAD EXTENSION COSTS) (2) FY '90 CONSTRUCTION MANAGEMENT RE-ESTIMATE \$2,791,100 (3) FY '91 CONSTRUCTION MANAGEMENT RE-ESTIMATE \$4,541,000 (4) FY '92 CONSTRUCTION MANAGEMENT RE-ESTIMATE \$4,051,000 (5) FY '93 CONSTRUCTION MANAGEMENT RE-ESTIMATE \$1,379,000
RIGHT-OF-WAY	\$91,837	\$10,501	\$102,138	\$110,305	\$1,940	\$112,245	\$10,107	(1) RESERVE TAINT ALLOWANCE REDUCED FROM REV 7 \$1,000,000 (2) CONDEMNATION COSTS \$9,057,300 (3) GAS TANK REMOVAL \$50,000
DCIP	\$13,086	\$40,440	\$53,534	\$52,762	\$841	\$53,603	\$69	(1) RE-CALCULATED ON REVISED CONTRACT VALUES (2) OFFSET BY RE-NEGOTIATED EXCESS LIABILITY COVERAGE
PRELIMINARY ENGINEERING	\$32,400	\$0	\$32,400	\$32,800	\$0	\$32,800	\$0	
SUBTOTAL OTHER COSTS	\$73,519	\$196,631	\$270,150	\$260,970	\$3,781	\$264,751	\$34,601	
CONTINGENCY		\$74,143	\$74,143	\$18,100	\$0	\$18,200	N/A	10% OF UNEXPENDED OTHER COSTS
TOTAL OTHER COSTS	\$73,519	\$270,774	\$344,293	\$279,070	\$3,781	\$282,951	\$34,601	

EXHIBIT IV - 5
DESIGN ESTIMATE ANALYSIS
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

CONTRACT	CONTRACT DESCRIPTION	DATE OF ESTIMATE	CONTINGENCY %	ESTIMATOR AMOUNT	ESTIMATOR AMOUNT	ESCALATION TO 1985	1985 \$	LAST SCHEDULE REVISION	BASE 1985 \$	ESCALATION FACTOR TO JOB MIDPOINT	ESTIMATE AT MIDPOINT	REMARKS	
A111	SANTA FE AVE RESTORATION	12/85					145,000	-	145,000	1.194	173,130		
A116	YARD SITE FENCING	4/18/89	10 X	37,300	373,000	1.145	325,764	-	325,764	1.214	395,477	BASE ESTIMATE	
A117	YARD SITE LIGHTING	12/85					658,000	-	658,000	1.206	793,548		
A118	YARD SITE LANDSCAPING	12/85					368,000	-	368,000	1.210	445,280		
A124	DUCOMMON/JACKSON STS. RESTORE	7/85					35,000	-	35,000	1.230	43,050		
A136	UNION STATION, STAGE II												
	BASE	7/85					9,698,000	264,000	9,434,000	1.230	11,603,820		
	WEST ENTRANCE	6/12/89	15 X	491,400	3,276,000	1.145	2,861,135	-	2,861,135	1.230	3,519,196	BASE ESTIMATE	
	STAIRWAY #10	6/12/89	15 X	41,100	274,000	1.145	239,301	-	239,301	1.230	294,340	BASE ESTIMATE	
											15,417,356		
											14,621,320		
A138	UNION STATION SITEMARK	6/21/89					5,875,000	28,000	5,847,000	1.246	7,285,362		
A139	UNION STATION LANDSCAPING	6/21/89					3,786,000	1,000	3,785,000	1.259	4,765,315		
A147	CIVIC CENTER STA, STAGE II	4/24/89	10 X	1,460,000	14,600,000	1.145	12,751,092	191,000	12,751,092	1.234	15,734,847	BASE ESTIMATE	
								NOT INCLUDED					
A157	5TH/MILL STA, STAGE II	8/85	10 X	1,136,550	11,365,500		11,366,500	333,000	11,033,500	1.230	13,571,205	BASE ESTIMATE ESC.	
A185	MIL/ALV STA RESTORE	12/85					667,000	16,000	651,000	1.251	814,401	814,401	
A186	MIL/ALV STA LANDSCAPING	12/85					98,000	2,000	96,000	1.251	120,096	120,096	
A187	MIL/ALV STA, STAGE II	6/7/89	10 X	1,411,793	14,117,934	1.145	12,330,073	186,000	12,330,073	1.218	15,018,029	BASE ESTIMATE	
								NOT INCLUDED					
A655	TRANSPORTATION TEST CENTER	7							500,000	1.218	609,000	609,000	
A671	LOCOMOTIVE PROCURE (UNINOG)	12/85					245,500	14,000	231,500	1.218	281,967	281,967	
A672	FLAT CAR PROCUREMENT	12/85							47,000	1.259	59,173	59,173	
A675	CRANE PROCUREMENT	12/85							210,000	1.251	262,710	262,710	
A680	OPERATIONAL GRAPHICS PROCURE	12/85					111,000	6,000	105,000	1.214	127,470	127,470	
A730	FIXED SHOP EQUIP-PROCURE/INSTALL	12/85							25,000	1.198	29,950	29,950	
A735	TREE STAND SHOP EQUIP PROCURE	12/85							295,000	1.198	353,410	353,410	
A760	SIGNS/GRAPHICS	12/85					1,156,000	(9,000)					
								140,000	1,287,000	1.198	1,541,826	ADD LRT	
A770	RUBBER-TIRED VEHICLE PROCURE	12/85							230,000	1.218	280,140	280,140	
A775	MOBILE EMER & MAIN EQUIP PROCURE	12/85							338,000	1.230	415,740	415,740	
A780	FURNITURE PROCURE	12/85							169,000	1.259	212,771	212,771	
A785	FIRE SUPPRESS EQUIP PROCURE	4/85							14,000	1.234	17,276	17,276	
A790	1ST STORES/CONSUM PROCURE	12/85							105,000	1.234	129,570	129,570	
A797	ART-IN-TRANSIT	12/85									948,000	948,000	
TOTALS				\$4,578,143	\$44,006,434		\$62,716,366	\$1,172,000	\$64,116,365		\$79,846,100	TOTAL INCLUDING LINE ITEMS	
												\$73,093,954	WITHOUT CONTINGENCY
NOTE: VALUES ON THIS SHEET ARE CALCULATED BY COMPUTER AND DIFFER FROM SOURCE DOCUMENT												ALLOWANCE:	\$6,752,146

EXHIBIT IV-3
PROBABLE CASE
SUMMARY ROD - EXTENSION COSTS
SOUTHERN CALIFORNIA
RAPID TRANSIT DISTRICT

Not in Estimate Feb 17

Escalator
 not in
 cost
 Term

POB 7
 POB EST
 FIC 4

PROPOSED R.O.D. DATE EXTENSION
 METRO-RAIL NOS-1
 DATE: 3/20/89

PROBABLE CASE
 SUMMARY R.O.D.-EXTENSION COSTS
 (\$000) Same as previous
 CASE III SHEET 6 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	REVISION & FORECAST	SCOPE CHANGE FORECAST	ESCALATION INCREASE FORECAST	CONTRACT DURATION INCREASE	CONTRACTOR CAUSED PRORATES	PROPOSED CONTRACT FORECAST	PROBABLE PROPOSED COST INCREASE	PESSIMISTIC PROPOSED FORECAST	PESSIMISTIC +/- INCREASE
FACILITIES CONTRACTS										
*A130	YARD LEADS AND TRANSFER ZONE	37,303	2,104	499	4,955	(3,303)	41,558	4255 4,255	5,996	1,741
*A135	UNION STATION-STAGE I	65,449	860	237	1,342	(1,342)	66,554	1105 1,105	5,494	4,389
*A141	UNION STA/STH HILL INCL CIVIC CENTER STATION	75,788	0	423	4,383	(4,383)	76,211	423 423	577	154
*A145	STH & HILL STATION - STAGE I	49,750	300	340	2,008	(803)	51,594	1544 1,844	3,391	1,547
*A146	LINE-5th/HILL STATION TO 7th/FLOWER STATION	20,021	0	123	973	(973)	20,144	123 123	1,326	1,203
*A165	7th/FLOWER STATION - STAGE I	50,508	0	282	1,506	(1,004)	51,292	423 784	784	0
*A171	LINE-7th/FLOWER STA TO WILSHIRE/ALVARADO	26,711	292	0	0	0	27,003	292 292	517	225
*A175	WILSHIRE/ALVARADO STATION - STAGE I	24,982	0	0	0	0	24,982	0 0	575	575
STAGE II CONTRACTS										
A136	UNION STATION - STAGE II	9,434	N/A	302	0	0	9,736	302 302	462	160
A147	CIVIC CENTER STATION - STAGE II	10,886	N/A	218	0	0	11,104	218 218	261	43
A157	5th/HILL STATION - STAGE II	11,134	N/A	267	0	0	11,401	267 267	824	557
A167	7th/FLOWER STATION - STAGE II	12,385	N/A	50	0	0	12,435	50 50	99	49
A187	WILSHIRE/ALVARADO STATION - STAGE II	7,379	N/A	30	0	0	7,409	30 30	89	59
SYSTEMS CONTRACTS		51,218		866	0	0	52,084	866	1,735	869
STAGE II CONTRACTS										
*A610/A115	TRACKWORK INSTALLATION	23,617	0	279	1,827	0	25,723	2106 2,106	1,827	(279)
*A620	AUTOMATIC TRAIN CONTROL PROCURE/INSTALL	11,599	0	224	927	0	12,750	1151 1,151	2,260	1,129
A631	TRACTION POWER EQUIPMENT INSTALLATION	6,281	0	251	1,090	0	7,622	1311 1,311	1,836	495
*A640	COMMUNICATIONS PROCURE/INSTALL	35,998	0	654	4,990	0	41,642	5430 5,430	8,531	2,887
OTHER COSTS										
GENERAL CONSULTANT		163,207	0	0	359	0	163,566	359	628	269
CONSTRUCTION MANAGER		83655	0	0	897	0	84,552	897	1,569	672
OWNER-CONTROLLED INSURANCE		53145	0	0	1,395	0	54,540	1,395	2,441	1,046
AGENCY COST		116013	0	0	797	0	116,810	797	1,395	598
ROD EXTENSION INCREASE...PROBABLE CASE		946,463	3,564	5,044	27,449	(11,808)	970,712	23,383	42,637	18,388

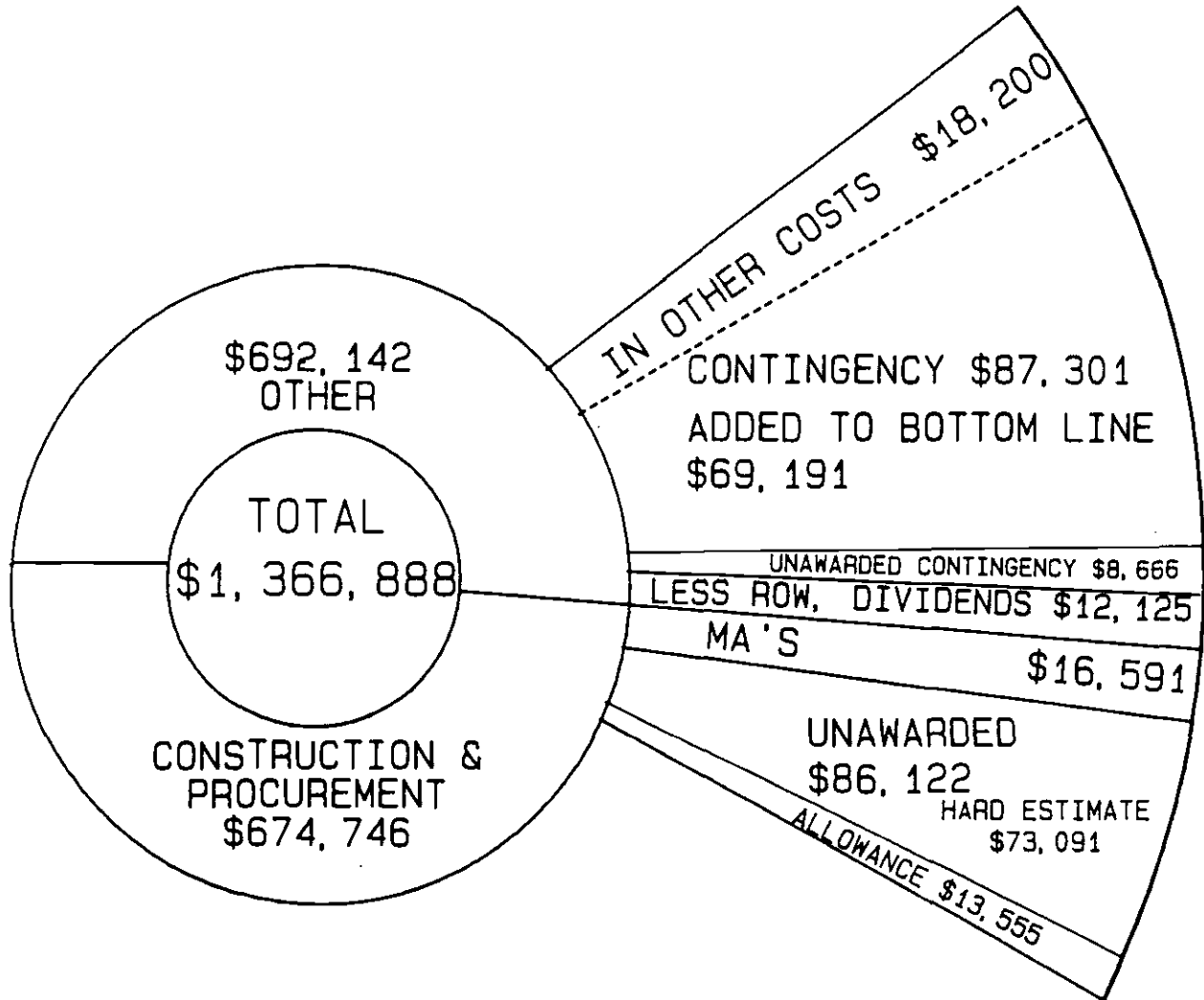
*INCLUDES ESCALATION, CONTRACT DURATION, AND SCOPE CHANGES

RODEX3A

① Reduced OFFSET By Contractor Claim (300,000)
 ② Reduced FOR LIGHT-RAIL PORTION (605,000)

18,048

EXHIBIT IV-7
 ALLOWANCES ASSOCIATED WITH
 UNAWARDED CONTRACTS
 SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT



PROJECT SCHEDULE EVALUATION
ANALYSIS AND ASSUMPTIONS

5/15/89
Data Date 3/10/89

Method of Approach

Definitions

Each major facility and systems contract that has the potential of impacting the critical path, and thus the Revenue Operations date (ROD), has been evaluated to determine the optimistic, pessimistic and probable schedule scenarios. In addition an analysis was conducted of the measures that would have to be taken to maintain the current ROD and allow adequate time for the Systems work.

The following definitions were applied to develop each scenario:

Optimistic - optimum productivity rates, minimal potential delays

In general this case assumes that past problems will not be repeated, that minimal future contamination, archaeological finds or underground obstructions will be found; and that contractors will work in earnest to progress the work. Existing delays are not mitigated, except where a high probability is indicated.

Pessimistic - conservative productivity rates with allowances for all potential delays.

In general this case assumes past problems will continue, that areas of potential obstructions, contamination or archaeological finds will actually be found, and that there will be no significant changes in contractor performance.

Probable - reasonably achievable production rates and reasonable allowances for potential delays.

In general this case applies considerable judgment on the potential for future problems and the ability of each contractor to mitigate existing problems. Reasonable improvements are assumed where the contractors indicate an ability and desire to mitigate. Allowances for potential delays consider the remaining uncertainty on each contract in terms of remaining underground excavation and an assessment of the reasonableness of the scheduled concrete production rates.

Maintain ROD - required conditions and production rates to meet 1/4/93 ROD

This case describes the steps which must be taken to bring the milestones dates in the probable scenario back to those dates necessary to hold the 1/4/93 ROD, including a 6 month Pre Revenue Operations period for final testing and training. A judgment is also made on whether these steps and the resultant required production rates are feasible.

Method of Analysis

Each contract schedule was studied independently with the Resident Engineer, Project Engineer and assigned Scheduler to determine the factors that could affect the remaining schedule. Potential impacts to each of the factors were assessed and resultant schedules developed for each of the four

cases, ie., optimistic, pessimistic, probable, and holding the current ROD. The Facility contracts were studied first. Once their impacts and access dates were determined, schedules were developed for each of the Systems contracts for each case using the forecasted access dates and contractually approved Systems schedule durations as a basis, with adjustments for the assumptions in each case. From these two inputs a combined MOS-1 schedule was prepared for each scenario, resulting in different Revenue Operations Dates. This information was then reviewed with senior management at PDCD and RTD, and modifications were made to incorporate their judgments. For all scenarios, a contingency was also included between facilities and systems contracts to cover unanticipated events or circumstances, and a 6 month Pre-Revenue Operations period was maintained. Following final review and acceptance of these schedules, the information was summarized for presentation to the RTD Board of Directors.

An analysis was also made of areas where changes in logic could potentially be made for future recovery of time should it become necessary. This analysis was prepared to provide additional information on the amount of real contingency in the schedule.

Summary of Results

Based on the assumptions in the attached analysis, the resultant MOS-1 schedules are as follows:

	<u>ROD</u>	<u>Slippage (months)</u>
Revision 6D	4 Jan 93	0
Optimistic	1 May 93	-4.0
Pessimistic	15 Mar 94	-14.5
Probable	10 Sep 93	-8.2

Contract Analysis

General Assumptions

1. 3 month contingency between A610 and A620.
2. 3 month contingency between Stage II and A620.

Contract A130, Main Shop and Yard Leads

Work is currently 3 months behind schedule. Three schedule problems confront this contract. The first is delayed approval of the slurry wall excavation support system, which delayed construction of the slurry wall. The slurry wall support design was finally approved in early March, 4 months late. The support design for Bent #4 at the 101 freeway is still not approved by Caltrans and prevents slurry wall excavation in the 101 freeway area. The second schedule problem is potential tunneling delays due to the contractor's planned use of the A141 equipment, which will available 5 months later than planned. Contractually the A130 Contractor should not rely on equipment from other jobs, but he has. Alternative equipment may be available, which could mitigate this delay. The third is delays to Caltrans busway work at the south end of the station. Caltrans must complete their work before the slurry wall can be completed, and Caltrans is behind schedule. In addition, this contract has potential

Schedule Evaluation Page 3

contaminated soil problems, the extent of which will not be known until the ground is excavated.

CASE	TRACKWORK	DAYS	STAGE II	DAYS	COMPLETION	DAYS
Current Contract	6 Mar 90		n/a		8 Jun 90	
REV 6D	6 Mar 90	0	n/a		8 Jun 90	0
OPTIMISTIC	15 Jul 90	131	n/a		17 Oct 90	131
PESSIMISTIC	15 Feb 91	346	n/a		15 May 91	341
PROBABLE	15 Dec 90	284	n/a		15 Feb 91	252

Note: Days are calendar day variance from the Rev. 6D schedule.

Assumptions

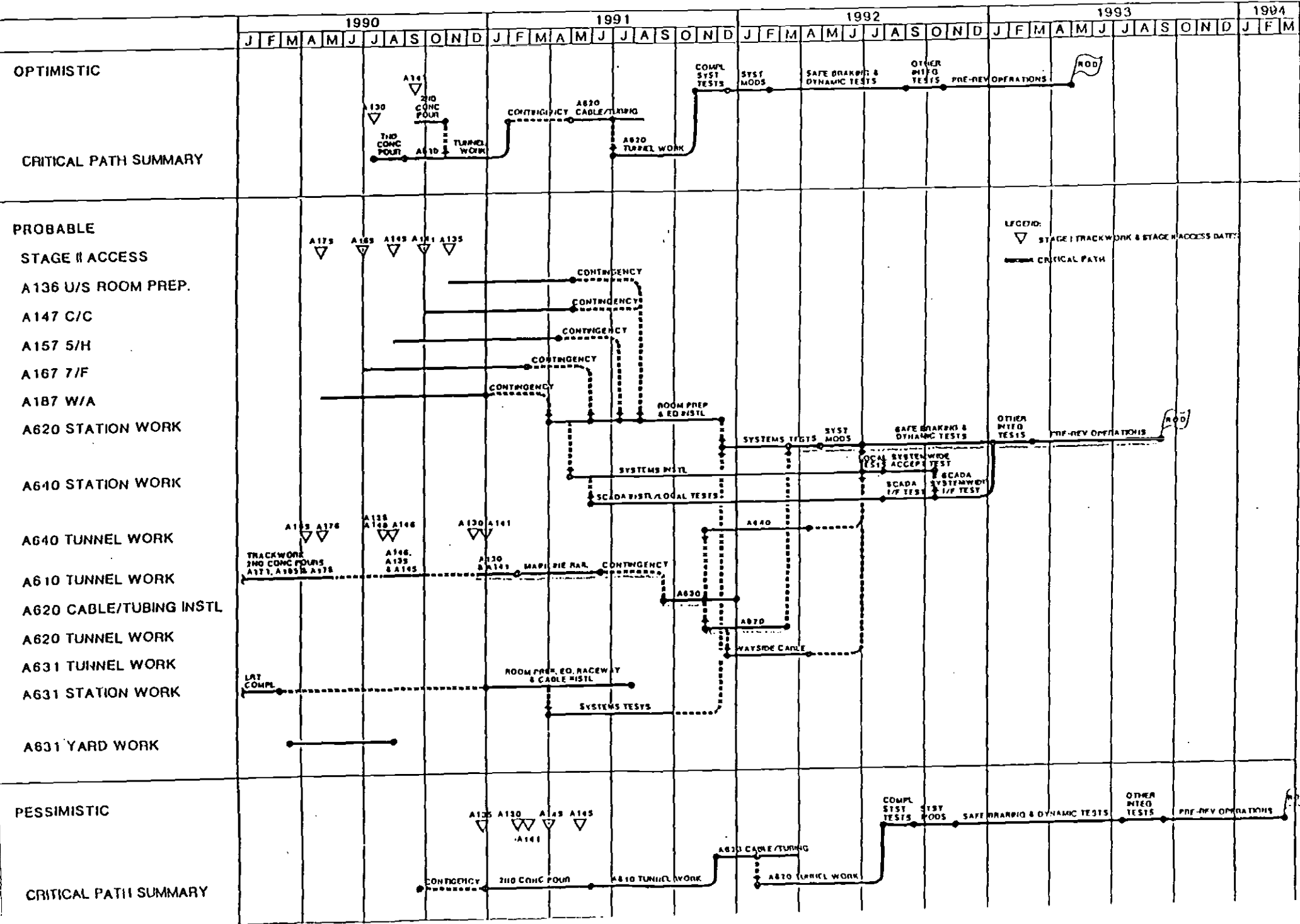
Optimistic

1. The Caltrans Contractor will not complete the 101 Freeway ramp work until 1 Apr 89, which will cause a 4 1/2 month delay to completing the slurry wall excavation.
2. The potential 5 month tunnel machine delivery delay, while waiting for the Contract A141 tunnel machine to be available, will be mitigated by procuring alternative, less sophisticated tunnel equipment. The equipment would be delivered in five months (8 Sep 89), assembled in 22 calendar days, and digging would start by 1 Oct 89, which is the current schedule date.
3. Grouting of the tunnel will take place on 3 shifts, instead of the currently scheduled 1 shift.
4. Hazardous materials are not found in the excavation of the tunnel or tunnel/transfer zone area.
5. The combined effect of the above 4 items is a 4 1/2 month schedule delay.

Pessimistic

1. The Caltrans Contractor will not complete the 101 Freeway on ramp work until 5 Jun 89, which will cause a 6 month delay to completing the slurry wall excavation.
2. The Contractor is unable to find alternative tunnel equipment and will receive the A141 tunnel machine on 15 Mar 90, which would cause a 6 1/2 month delay in starting tunnel construction. This delay is concurrent with the slurry wall delay.
3. Tunnel machine setup time will be slower and production tunneling for this short run will be 15'/day (versus the 40'/day scheduled), causing a 1 month impact.
4. Hazardous materials are found during the excavation of the North Transfer Zone box structure and cause a 2 month delay.
5. Archaeological finds are uncovered during excavation of the north transfer zone box structure and cause a 2 month delay.
6. The combined effect of the above items is an 11 1/2 month delay from the current schedule.

MOS-1 PROJECT SCHEDULE EVALUATION



Probable

1. The Caltrans contractor will complete the 101 Freeway on ramp work by 5 June 1989, which will cause a 6 month delay to completing the slurry wall excavation.
2. The Contractor is unable to find alternative tunnel equipment and will receive the A141 tunnel machine on 15 Feb 90, which causes a 5 1/2 month delay in starting tunnel construction. This delay is concurrent with the slurry wall delay.
3. Tunnel machine setup time will be slower than planned and production tunneling will proceed at 28'/day versus the the 40'/day scheduled rate, causing a 1/2 month delay.
4. Hazardous materials are found during the excavation of the North Transfer Zone box structure and cause a 2 month schedule delay.
5. Archaeological finds are uncovered during excavation of the North Transfer zone box structure which may cause a 1 month schedule delay.
6. The combined effect of the above items is an 9 1/2 month delay from the current schedule.

Maintain ROD - Recover 9 1/2 months from the Probable Schedule¹

Summary - An additional 3 months must be recovered beyond the optimistic schedule, which may be infeasible to achieve. The tunnel equipment must be delivered by 01 Aug 89 and concrete work in the Traction Power Substation must be reduced to 4 months. It is currently scheduled for 8 months.

1. The tunnel equipment must be delivered by 01 Aug 89, which would require the contractor to commit to a purchase by April 1. Tunnel excavation would need to proceed on a 3 shift basis (2 production and 1 maintenance) and achieve 40'/shift or 80'/day.
2. The period of time for tunnel grouting is 7 months must be reduced to 3 months.
3. Concrete activities in the Traction Power Substation must accelerate to complete the work in 4 months, rather than the 8 months scheduled. This could possibly be achieved by working 3 shifts, 7 days a week, but the feasibility of maintaining this rate is not realistic.

Contract A135, Union Station, Stage I

Work is several weeks behind schedule but in general is proceeding well. Delays were experienced on the electrical work, but these are being mitigated. Slurry wall construction is now the chief construction activity, and some delays have been experienced due to equipment problems. The contractor has been able to add a second shift, to work Saturdays, and is recovering. An agreement was successfully negotiated between AMTRAK/LAUPPT and the Contractor, which allows earlier excavation of the west end of the station, thus eliminating a potential delay. The finding of larger than expected asbestos during the early work is currently being handled without impact to the schedule. A few archaeological finds have been made, but no contaminated materials have yet been found. The schedule on this contract is stringent, and

1. The calculation of the schedule recovery time is the difference between the probable date and the Rev 6D date, plus an additional 2 months which was added to Pre Revenue Operations to be achieve a 6 month Pre Revenue Operations Period consistent with the other scenarios. This additional 2 months was then reduced where possible to take advantage of late access dates from Revision 6D.

further slurry wall delays could occur as well as contamination or archaeological findings during excavation.

CASE	TRACKWORK	DAYS	STAGE II	DAYS	COMPLETION	DAYS
Current Contract	29 May 90	0	7 Sep 90	0	29 Apr 91	0
REV 6D	29 May 90	0	7 Sep 90		29 Apr 91	0
OPTIMISTIC	29 May 90	0	07 Sep 90	0	29 Apr 91	0
PESSIMISTIC	28 Dec 90	213	08 Apr 91	213	28 Nov 91	213
PROBABLE	29 Jul 90	61	07 Nov 90	61	29 Jun 91	61

Note: Days are calendar day variance from the Rev. 6D schedule.

Assumptions

Optimistic

1. The contractor begins earlier than planned the demolition of the Railway Express Agency Building, which will allow excavation of the west station area to begin ahead of schedule.
2. The slurry wall delay is mitigated by working a second shift.
3. During excavation of station, no archaeological finds or hazardous materials are found which could impact the excavation of soil from the station area.
4. Other minor delays are mitigated through addition of a second shift as necessary.
5. The above items result in no delay to the current schedule.

Pessimistic

1. The Pre-Phase I electrical and turnout work delays are not mitigated and cause a 1 month delay.
2. Archaeological finds are made during station excavation and cause a 1 month delay.
3. Hazardous materials are found during station excavation and cause a 1 month delay.
4. The slurry wall construction productivity rate does not improve in Phase I and II, which causes a 1 month delay.
5. Additional asbestos is located in the electrical work areas, which requires special handling, causing a 1 month delay.
6. Added work scope changes or coordination difficulties with Amtrak/LAUPY cause a 2 month delay to schedule.
7. The combined effect of the above items is a 7 month schedule delay.

Probable

1. During station excavation archaeological finds are made which cause a 1 month delay.
2. During station excavation hazardous materials are found which cause a 1 month delay.

3. The contractor successfully mitigates any additional delays by working extra shifts or extension of work the week to 7 days.
4. The combined effect of the above is a 2 month delay.

Maintain ROD - Recover 3 months from the Probable Schedule

Summary - To recover 3 months, 1 month would need to be saved from station box excavation, 1 month from station concreting and 1 month from Phase II (center station area) concreting. These accelerations could be made by adding shifts and are feasible.

1. One additional month would need to be recovered during station excavation, preferably in the early phases, by adding a second excavation shift. The first shift would excavate the clean soil. Any hazardous materials would have to be moved aside for a second shift and hauled away on that shift.
2. During the first two months of station box concreting, a second shift would need to be added, which would reduce the concrete period from 10 to 9 months, saving 1 month.
3. Accelerate concrete operations in the Phase II station box construction by adding a second shift, which would save 1 month.

Contract A141, Civic Center Station and Tunnel from Union Station Stage to Fifth/Hill

Work is currently 2 months behind the Revision 6D schedule, which included a 8 month trackwork access delay to 15 June 90 and an 6 month delay to Stage II access to 02 April 90, as a result of delayed site access for construction of the tunnel shaft. Contract A141 is the critical path facilities contract and still the center of continuing scheduling problems. The contractor has submitted his appraisal of the schedule recovery possible under the recovery change orders issued, and a final commitment is under negotiation. Tunneling progress has been delayed by equipment problems and unfavorable soil conditions. Equipment adjustments have been made, but the rate of progress has not met planned levels, despite the favorable reputation of the tunneling machine. Station construction was proceeding well until a recent monthlong shutdown for replacement of overstressed struts.

CASE	TRACKWORK	DAYS	STAGE II	DAYS	COMPLETION	DAYS
Current Contract	27 Oct 89		13 Oct 89		13 Apr 90	
REV 6D	15 Jun 90	0	2 Apr 90	0	9 Aug 90	0
OPTIMISTIC	17 Sep 90	94	4 Jun 90	63	15 Oct 90	67
PESSIMISTIC	1 Mar 91	259	1 Nov 90	213	1 May 91	265
PROBABLE	2 Jan 91	201	1 Sep 90	152	1 Mar 91	204

Note: Days are calendar day variance from the Rev 6D schedule.

Assumptions

Optimistic

1. The current 2 month delay is not mitigated.

2. The tunnel equipment problems subside and the remaining tunnel excavation is completed at a rate of 30'/day through the first 10 days of each run, and 79'/day thereafter, causing an additional delay of 1 month.
3. The scheduled concrete production rates are maintained.
4. These items result in a 3 month delay to trackwork access and a 2 month delay to Stage II and completion.

Pessimistic

1. The current 2 month delay is not mitigated.
2. Additional tunneling excavation problems occur resulting from soil stabilization problems or tunnel machine problems. The average tunneling rate for the remainder of the first AR drive is 47'/day. The average tunneling rate for the three remaining tunnel runs is 30'/day for first 10 days and 47'/day thereafter, except for the first 900' of AL tunnel through the cobblestones and curve, which has a rate of 30'/day. These rates cause a delay of 3 1/2 months.
3. Slower rate of concrete placement for tunnel invert, liner and walkway resulting in a 3 month delay.
4. These items result in an 8 1/2 month delay to trackwork access and Stage II access is delayed 7 months by the tunneling delay, plus an additional 1 month from tunnel concrete delays.

Probable

1. The current 2 month delay is not mitigated.
2. Some additional tunneling excavation problems occur. The average tunnel rate for remainder of AR drive #1 is 53'/day. Average tunnel rate for the three remaining tunnel runs is 30'/day for first 10 days and 53'/day thereafter, except the first 900' of AL tunnel through the cobblestones and curve, which has a rate of 30'/day. These rates cause a delay of 2 1/2 months.
3. Slower rate of concrete placement for tunnel invert, liner and walkway resulting in 2 months delay.
4. These items result in a 6 1/2 month delay to trackwork access. Stage II access is delayed 5 months by the tunneling delay.

Maintain ROD - Recover 8 1/2 months from the Probable Case.

Summary - To recover 8 1/2 months from the probable schedule, tunneling would have to proceed at an average rate of 93'/day for the full production portions of the the remaining tunnel drives, which is well above the 21'/day achieved thus far, and concreting must increase productivity by 36%, which on a 3 shift operation as currently planned can only be achieved with larger forms. Neither of these requirements appears feasible.

1. To date (10 Mar 89) the average tunneling excavation rate is 21'/day. The improved soil conditions began at 900', and several days over 60'/day have been achieved, but mechanical problems persist and these rates have not been sustained. To meet the required tunnel excavation completion date of 9/1/89, tunneling production would have to proceed at an average rate of 93'/day, calculated as follows:
 - a. A total of 175 calendar days are available. 74 days are scheduled non-production days for tunnel machine disassembly, moving, and reassembly between the 4 tunnel segments. An additional 30 days would be consumed for tunneling the first 900' of the AL tunnel,

assuming the soil conditions similar to the AL tunnel were found. The remaining tunnel drive is 6,624'. Tunneling 6624' in 71 days requires an average rate of 93'/day. If tunnel work proceeded 7 days a week, at 2 shifts/day with a 3rd shift for magnetometer probe drilling, an average of 47' must be excavated per shift. This rate, although technically achievable, is not practically feasible, because of inadequate time for tunnel machine maintenance, which now requires 1 to 2 days per week.

- b. In addition to tunneling acceleration, improvements would have to be made in the planned concrete placement rates. Rates in the current (1/9/89) contractor's schedule and required rates to avoid any impact to ROD are as follows:

	Scheduled	Required
Arch	73'/day	100'/day
Invert	93'/day	127'/day

Based on actual A171 production, these required rates are achievable, but they are well above what the A141 contractor plans to achieve. This concrete work is already planned for a 3 shift operation.

Contract A145, Fifth & Hill Station, Stage I

Work is currently 2 months behind schedule and excavation progress is further deteriorating. In the last month, (February 1989), 16 of 20 workdays were lost. The problems lie with contaminated soil, the extent of which remains to be determined, with deficient lagging, which must be corrected, with construction of a sewerline for which the contractor is in disagreement, with a manhole construction, which the contractor is also failing to proceed with over design disagreements, with the excavation support system installation at the northend, and with water installation at the south end. The contractor is not providing the manpower to meet the schedule commitments; instead he is resorting to disagreements rather than diligently pursuing the work.

CASE	TRACKWORK	DAYS	STAGE II	DAYS	COMPLETION	DAYS
Current Contract	19 Feb 90	0	19 Feb 90	0	17 Aug 90	0
REV 6D	19 Feb 90	0	19 Feb 90	0	17 Aug 90	0
OPTIMISTIC	15 Jun 90	116	15 Jun 90	116	15 Oct 90	59
PESSIMISTIC	15 May 91	450	15 May 91	450	1 Dec 91	471
PROBABLE	15 Aug 90	177	15 Aug 90	177	1 Feb 91	168

Note: Days are calendar day variance from the Rev 6D schedule.

Assumptions

Optimistic

1. No mitigation of current 2 month delay.
2. No additional excavation delays due to inefficiencies. Work is now below the utilities at 4th and 5th streets, which previously hindered progress at each station bulkhead.
3. Will encounter limited additional contaminated soil, causing 1 month additional delay.
4. Some concreting inefficiencies causing a 1 month delay.
5. The net impact of the above items is a 4 months delay.

Pessimistic

1. Projecting the current excavation inefficiency of 35% (due largely to lack of adequate manpower), excavation will be delayed by 4 1/2 months, including the current 2 month delay.
2. Will encounter more extensive contaminated soil, causing a delay of 4 months, assuming the soil has to be transported to Bakersfield in covered trucks and weighed at the hopper. (Utilization of a contaminated soil subcontractor could reduce this impact.)
3. The contractor has not placed any concrete upon which to gauge his productivity. If his productivity were 70% of his approved schedule, including forming rebar, embed installation, and pouring and striping of concrete, the scheduled 14 month duration would slip to 20 1/2 months, a delay of 6 1/2 months.
4. The net impact of the above items is a 15 month delay.

Probable

1. No mitigation of the current 2 month delay.
2. Excavation inefficiencies will continue at a much reduced level and impact the schedule by 1 month.
2. Additional contaminated soils causing a 2 months delay.
3. Some loss of concrete productivity, adding a 1 month delay.
4. The net impact of the above items is a 6 month delay.

Maintain ROD - Recover 7 months from Probable Case

Summary - To recover 7 months, the Contractor must be directed to proceed with all work currently on hold, and adequate contaminated soil removal crews and equipment must be available 24 hours/day. The required manpower would be several factors above what has been applied to date. Even with these measures, combined with expected acceleration costs, it is unlikely that events could be controlled within the required schedule dates.

1. The deficient lagging will slow excavation progress while new lagging is placed. A potential cure is to proceed with the work on a force account basis with direction to minimize excavation delays.
2. The current hold on telephone manhole 793 construction prevents work while the natural ground level platform can access the work. Work must be directed to proceed by 01 April 89 to prevent any impact from continued excavation with costs resolved later.

3. The current hold on sewerline "C" work delays sewerline support work necessary to proceed with excavation. The contractor is refusing to proceed with the work. The contractor must be directed to proceed with the work with costs resolved later.
4. Ground water is saturating the soil, which slows excavation. It also slows construction of the station support system affecting welding and lagging. It interferes with concrete form work of the inverts and walls through the accumulation at the south end where concrete is being poured. Resolution is to locate the origin of the flow and drill well points outside the station to cut off the flow into the station.
5. Contaminated soil is slowing the excavation rate. Additional time is spent for detection, for separation of contaminated soils from acceptable soils, for weighing and covering hauling trucks, and decreased availability of adequate number of trucks for both operations. Contaminated soils are also delaying work on the structural support system. To remedy this situation, trained personnel would need to be available 24 hours/day to operate the sniffer equipment. Trucks would have to be available to haul the contaminated materials whenever they are found. Additional soils analysis should be done to better define the planes and profiles of likely contaminated areas. A dump site should be available in the local area for secondary storage prior to long distance hauling. Hauling should be done on more than one shift. The contractor should be directed via force account on when and where to haul.
6. In addition, the remaining excavation requires acceleration. To meet the schedule, excavation at the south bulkhead needs to be completed by 15 April 1989 and total excavation needs to be completed by 15 May 1989. If these dates could be met, 11 days of negative float would transfer to the concreting operation and need to be recovered here. From the date this analysis is written (10 Mar 89) to May 15 excavation completion is 45 work days. The excavation rate would need to be 2 shifts at 900 cu yds per shift. A rate of 900 cu yds/shift is not realistic and 750 cu yards per shift is all that could be expected. At this rate 54 work days are required. In addition, the conveyor would be down for 5 days to move to Level IV excavation. Eight extra shifts would have to be added to recover these 5 days, which would nearly eliminate maintenance time for the excavation equipment.
7. The scheduled welding rate for the excavation support system would also have to be accelerated for levels III and IV to meet the 5 May 89 completion date. Each level has 620 star-packs (14/day), 104 struts (2 per day), 100 walers (2 1/2 per day), tube struts and 36 knee thrust struts(12 for each of 2 day period). This work would require 2 shifts, 6 days per week.
8. To meet the lagging requirement by May 15, the contractor would have to achieve 1,280 sq.ft/day, which would required 2 crews at 6 days a week.
9. To meet the trackwork and station access dates, concrete work must be completed by 13 Jan 90, which would allow 9 months of work. The contractor's schedule allows 14 months for this work. To accelerate 5 months, one concrete pour must be made each day, which might be achieved with a 3 shift crew.

Contract A146, Tunnel 5th/Hill to 7th/Flower

Work is 2 weeks behind the currently approved schedule, and this contract is now only 1 month off the critical path. Considering past performance and continuing current delays, it is unlikely that future delays can be maintained within the current critical path. After an 8 month shut down in 1988, work has been shut down another 2 months in 1989 for modification of the shield and to provide for chemical grouting. Since crews are not available for a second shift, work is

confined to one 12 hour shift, creating poor cycling times between grouting and tunneling, so that planned production of 30' per day may still be too optimistic.

CASE	TRACKWORK	DAYS	STAGE II	DAYS	COMPLETION	DAYS
Current Contract	29 May 89		n/a		29 May 89	
REV 6D	1 May 90		n/a		15 Jun 90	
OPTIMISTIC	21 Mar 90	-41	n/a		05 May 90	-41
PESSIMISTIC	1 Apr 91	276	n/a		15 May 91	273
Optional Pessimistic1	1 Feb 91	276	n/a		15 Mar 91	273
PROBABLE	1 Aug 90	160	n/a		15 Sep 90	169

1 Termination of Contractor

Note: Days are calendar day variance from the Rev 6D schedule.

Assumptions

Optimistic

1. Mitigate the current delays by tunneling at a 40'/day excavation rate. If the contractor cannot accomplish 40' Day, but 30' day, the schedule could be improved by working a 6 day work week.
2. The concrete installation rates would remain as scheduled in Rev 6D.
3. The net impact of the above items is a 6 week improvement to the current schedule.

Pessimistic

1. Resumption of tunneling could be delayed until manpower can be released from Contract A171 (This presumes that the Contractor will continue to act as he has in the past by trying to utilize one crew to perform two contracts.) The Contractor may keep his available personnel on Contract A171 in order to maintain current progress for concrete placement and would not reduce his crews until the AL arch is finished about June 1, 1989. The A171 Contractor is working 3 shifts/6 days a week on the AR invert concrete and will be starting both the AR concrete arch and AL invert in about two weeks. The start-up of A146 tunnel work would reduce his crew on the A171 Contract and decrease his rate of production on this contract concrete placement. The above delay would slip all the current 6D schedule activities and milestones by 3 months.
2. Delays due to additional unstable soils are very unlikely at this stage. A procedure has been developed to handle this situation, and there should be no further work stoppage if this situation is encountered again. Despite these precautions, an additional 2 weeks delay is seen as possible in the pessimistic case. We are expecting another 1,200 ft of potentially unstable soil, combined in both of the remaining AL and AR tunnels to be mined. Thus, we cannot expect to accomplish any better tunneling rate than 30'/day through this material (Tunneling 1 shift, Compact Grouting 1 shift, Chemical Grouting 60' ahead of Shield 1 shift)

- 3. Delays due to underground obstructions are a potential. The most probable underground obstruction would be an old oil well casing, which should be detected with the magnetometer probe. If a casing is encountered the contractor would have to hand excavate about 5 feet in front and 5 feet beyond the obstruction in order to remove it. This work would take about 5 work days. Essentially, the tunneling activity will come to a stop for about a week per occurrence. The pessimistic case is assumed to encounter four obstacles which could delay each tunnel excavation by 2 weeks, for a total of 1 month.
- 3. A misalignment, similar to that experienced on the A171 contract could occur, which would require work stoppage while the design consultant analyzed the design impacts. Depending on the severity of the misalignment, concreting would most likely be delayed by at least 2 months, while the impact to the Track Access Milestone could be as much as 6 months.
- 4. The contractor has experienced a high rate of crew turnover and labor shortages preventing double shift work. Also the long 12 hour shift he now works contributes to some loss of productivity. These considerations are factored into the 30'/day productivity in the pessimistic case.
- 5. The contractor may not achieve his projected rate of concrete placement. He plans 190'/day for invert, 160'/day for arch, and 320'/day for the walkways. Each tunnel is approximately 2,200 ft, thus they plan about 12 days to complete each invert, 14 days for completion of each arch, and 14 days for the walkways. The 6D Schedule reflects one month for inverts, 2 months for arches and 2 months for each walkway. If his actual concrete productivity is 30% of his most optimum concrete placement, there would be an additional 1 month impact to the schedule, calculated in workdays as shown in the following table. The Pessimistic construction time is 3 times the Optimistic Schedule, which results in a 24 workday (1 month) extension to the 6D schedule.

POUR	OPTIMUM	REV 6D	PESSIM.	VAR 6D
Invert	12 days	21 days	36 days	24days
Arches	14 days	42 days	42 days	0
Walkdway	14 days	42 days	42 days	0

- 6. Total impact to current schedule of 11 months delay as follows:

	<u>Delay</u>
Delayed resumption of Tunneling	3 Months
Obstacles and Soil Problems	1 Month
Alignment Problems	6 Months
Overoptimistic Concrete Rates	1 Month
 Total	 <u>11 Months</u>

Optional Pessimistic Case- RTD Terminates Shank/Ohbayashi

If a decision were made by 01 April 1989, to precede with contract termination, the following delay would occur as compared to 6D Schedule.

	Delay
No Work Action By Shank	1 Month
Advertise & Accept Contract Bids	3 Months
Review Bids	1 Month
Award Contract & NTP	1 Month
Contractor Mobilize & Install Tunnel Machine	3 Months
Total Impact to 6D Schedule	9 Months

Probable

1. No Mitigation of current 2 week delay.
2. Contractor will resume tunneling by 15 March 89, at the scheduled rate of 30' per day.
3. Some tunneling production delays will occur due to staffing or soil stabilization problems, causing a 2 month delay from the 30'/day schedule.
4. Some concreting inefficiencies leading to a 2 week delay delay.
5. The net impact of the above items is a 3 month delay.

Maintain ROD -Recover 6 months from Probable Case

Summary - To recover 6 months, the Contractor must work tunnel excavation at 3 shifts per day, 5 days a week, achieving a production rate of 90'/day with chemical grouting at the same pace. The 90'/day is the equivalent of 60'/8 hour shift, almost double what is now achieved on a single 12 hour shift. Concrete work would have to achieve the same production rate as this same Contractor achieved on the A171 tunnel.

1. The grouting/mining coordination is very important to the schedule. When he is working, the contractor now works one 12 hour shift and achieves an average tunneling excavation of 35'/day. To maintain the current program schedule, he must achieve 90'/day, with grouting at the same pace. However, grouting cannot proceed more than 20' beyond what can be tunneled on the next shift. If the tunneling or grouting pace falls short, then the next shift cannot work at full production, compounding the impact on the schedule. Currently, the contractor requires from 4 to 12 hours to grout 60', well below the required rate.
2. The AR walkway must be completed by 3 Feb 90. If tunneling began at the above required 90'/day rate on 20 Mar 89, and the Contractor worked at concrete production rates he has demonstrated on the A171 contract of 160'/day for inverts, 100'/day for arches, and 200'/day for walkways, the AL walkway would be complete on 15 Sep 89 and the AR walkway on 19 Jan 90 - two weeks ahead of the required date.

Contract A165, 7th and Flower Station, Stage I

Summary - Work is currently 1 month behind schedule due to rain delays affecting excavation and concrete slab placement inefficiencies. A second excavation shift has been added, and a second shift could be added to concreting, which could mitigate these delays. While there is no impact to the Metro Rail program from these delays, the Light Rail dates are impacted.

CASE	TRACKWORK	DAYS	STAGE II	DAYS	COMPLETION	DAYS
Current Contract	4 Jan 90	0	4 Apr 90	0	28 Sep 90	0
REV 6D	4 Jan 90	0	4 Apr 90		28 Sep 90	0
OPTIMISTIC	4 Mar 90	59	4 Jun 90	61	26 Nov 91	59
PESSIMISTIC	4 May 90	120	2 Aug 90	120	25 Jan 90	119
PROBABLE	8 Apr 90	94	2 Jul 90	89	26 Dec 90	89

Note: Days are calendar day variance from the Rev 6D schedule.

Assumptions

All dates are for Metro Rail milestones only; it is anticipated that the Light Rail Stage II milestone dates will be met.

Optimistic

1. Current 1 month delay cannot be mitigated.
2. Concrete delays totaling 1 month.

Pessimistic

1. No mitigation of current 1 month delay.
2. Concrete delays totaling 2 months.
3. Additional 1 month delay from interferences at the bulkhead with A146.

Probable

1. No mitigation of current 1 month delay.
2. Concrete delays totaling 1 months.
3. Additional 1 month delay from interferences at bulkhead with A146.

Maintain ROD - Recover 4 months from the Probable Schedule

Summary - To recover 4 months, the current 1 month delay would need to be mitigated with a second shift, which is quite feasible. The 1 month concrete delay and the 1 month bulkhead delay at A146 would need to be eliminated through additional second shift concreting. An additional month would have to be recovered from concreting. Potentially these savings are achievable.

Contract A171, Tunnel, 7th/Flower to Wilshire/Alvarado

Work is currently 2 months behind schedule due primarily by slower than planned tunnel excavation rates and concreting inefficiencies. Current work progress in the AL tunnel is at the point of completed invert concrete and start of arch form erection. In the AR tunnel invert concreting has begun. The present low concrete production rates coupled with crewing problems raises questions on the contractor's ability to reverse this trend. Alignment problems are still being corrected, but if done as scheduled will be concurrent with other delays. If struts are installed in the access shaft to relieve the A175 interface problem, inefficiencies of handling materials delivered through the shaft will be experienced.

CASE	TRACKWORK	DAYS	STAGE II	DAYS	COMPLETION	DAYS
Current Contract	23 Jul 89		n/a		23 Jul 89	
REV 6D	27 Nov 89	0	n/a	0	27 Nov 89	0
OPTIMISTIC	15 Oct 89	-43	n/a		15 Oct 89	-43
PESSIMISTIC	1 Jan 90	35	n/a		1 Jan 90	35
PROBABLE	27 Nov 89	0	n/a		27 Nov 89	0

Note: Days are calendar day variance from the Rev 6D schedule.

Optimistic

1. No mitigation of the 2 month delay to the current contract.
2. Installation of 3 struts in the access shaft causes a 2 week delay as a result of inefficiencies of handling materials through the reduced entrance area.
2. Slow concrete rate at the arch results in a 2 week delay. Other planned concrete production rates are maintained.

Linear Feet/Day

	AL	AR
Invert	150*	160
Arch	146	160
Walkway	155	198

*Actual = 142'/day

3. No AR tunnel alignment problems, and repair of current problems is done concurrently with other activities.

Pessimistic

1. No mitigation of current 2 month delay
2. Impact from installing the 3 struts in the access shaft of 1 1/2 month due to inefficiencies of handling materials through a reduced entrance area
3. Continued slow concrete production rate causes additional 1 month delay.
4. Problems in rectifying AR tunnel misalignment causes additional 1 month delay.

Probable

1. No mitigation of current 2 month delay
2. Impact of 1 month from installing the 3 struts in the shaft.
3. Concrete inefficiencies causes 1 month delay.
4. Rectifying AR tunnel misalignment can be done concurrent with concrete operations.

Maintain ROD - Recover 2 weeks from Probable schedule

Summary - The A171 schedule delays does not directly impact ROD, but failure to release the access shaft by 20 Oct 89 impacts the ability of A175 to complete on schedule to meet ROD. No more than a 1 month slip to the optimistic schedule will release the access shaft in time to eliminate any impact.

Contract A175, Wilshire/Alvarado Station, Stage I

Work is currently 4 months behind schedule due to a number of early startup problems including slow mobilization, slow sewer line relocation, and inadequate dewatering plans. Accelerated progress is being made in invert slab concreting, and half the slabs are completed. These early delays are being overtaken by the concurrent A171/A175 interface delay, where the southeast end of the station cannot be excavated until the A171 tunnel Contractor installs additional struts in the access shaft to balance the uneven load.

CASE	TRACKWORK	DAYS	STAGE II	DAYS	COMPLETION	DAYS
Current Contract	25 Jan 90		15 Sep 89		9 Mar 90	
REV 6D	24 May 90	0	5 Feb 90	0	12 Jul 90	0
OPTIMISTIC	15 Mar 90	-70	5 Feb 90	0	15 Jun 90	-27
PESSIMISTIC	27 Jun 90	34	27 Jun 90	142	10 Sep 90	60
PROBABLE	1 May 90	-23	1 May 90	85	5 Aug 90	24

Note: Days are calendar day variance from the Rev 6D schedule.

Assumptions

A175 delays are primarily caused by A171 delays in releasing the tunnel shaft.

Optimistic

1. A171 installs the struts in the shaft as planned.
2. There are no additional interferences from A171, and A171 makes good progress and releases shaft by 13 Sep 89.
3. No further delays.

Pessimistic

1. Installation of the struts is postponed to allow A171 to complete work unimpeded; results in delays to A175 excavation of 4 1/2 months from current approved Contract Schedule (which is a 1 month plus addition to the Rev. 6D schedule.).
2. No mitigation of current delays.

Probable

1. Struts are installed in the shaft now
2. Additional inefficiencies in excavation and concreting result in 2 months delay from the current approved Contract Schedule.

SYSTEMS CONTRACTS

General Assumptions

1. Yards and Shops - Yard and shop work is completed well in advance of need and does not impact schedule.
2. Stations - After Stage II contractors finish the room preparation, A620 (Automatic Train Control) begins equipment installation followed by A640 (Communication) and A631 (Traction Power Installation) equipment installation. A620, A640 and A631 arrange their work schedules on a weekly or daily basis through joint coordination committees. Systems testing in the stations is completed 1.5 months after tunnel work is completed. There is considerable interface between these contracts and with A650, Passenger Vehicles.
3. Tunnel - After A610 completion of trackwork in both tunnels, A620 begins installation of cables. Pulling of cables/tubing is completed in one alignment 2 months after start of work. A640 can work in the AR tunnel 2 months after A620 starts. A631 has access 3 months after A620 starts.
4. Tunnel durations are calculated from the date when full access is available. Actual/partial access may be available earlier.
5. Safe Breaking & Dynamic Testing has a 6 month duration, during which time A640 Local Tests and Systemwide Acceptance Tests can be performed as well as SCADA Interface Testing. Other Integrated Testing is allowed a 2 month duration following these tests.
6. Pre-revenue Operations has a 6 months duration.

Contract A610/A115 Trackwork Installation/Yard Storage

Following recent issuance of a change order granting a 79 day time extension for differing site conditions and design clarifications affecting underground utility installation, work is currently on schedule.

CASE	YARD TRACKWORK	DAYS	CONTACT RAIL	DAYS	COMPLETION	DAYS
Current Contract	07Mar 90		14Aug 90		31 Oct 90	
REV 6D	16 Mar 90	0	14 Dec 90	0	11 Jan 91	0
OPTIMISTIC	16 Mar 90	0	14 Dec 90	0	11 Apr 91	
PESSIMISTIC	15 Jun 90	91	17 Feb 92	-430	05 May 92	-480
PROBABLE	16 Mar 90	0	14 Jun 91	-182	30 Aug 91	-231

Note: Days are calendar day variance from the Rev 6D schedule.

Assumptions

Optimistic

1. Based on optimistic Facility trackwork access dates.
2. Durations and logic based on the approved May 1988 schedule, except the contractor's second pour crewing logic has been changed to meet the revised access sequence. New crewing ties are added based on current trackwork access dates.
3. A duration of 8 months for concrete pad construction has been maintained for late start dates.
4. Trackwork in the tunnel starts 2 weeks after all concrete work is completed.
5. Trackwork starts from the portal to Wilshire/Alvarado and takes 4.5 months to complete.

Pessimistic

1. Based on access delays from pessimistic facility schedules.
2. Same logic as optimistic.
3. Possible alignment tolerance problems or change/claim problems. Contractor is working 5 days, 1 shift per day and has ample opportunity to mitigate own delays. However, for these and other possible delays caused within the contract, productivity has been decreased by 30%, resulting in a 30% increase in durations.

Probable

1. Schedule based on probable station/tunnel access dates.
2. Same logic as optimistic.
3. No significant delays from contractor performance.

Contract A620, Automatic Train Control

Work on A620 is currently in the design stage and design is 80% complete, calculated according to the following logic. There are 7 design packages, which are vehicles, yard and shops, and the five stations, and product submittals, such as switch machines, signals, and wayside equipment. Preliminary design and product submittals have been completed on all stations, which accounts for 60% of the work. Final design has been completed on 3 of 7 design packages, and is close to completion on a fourth package; thus final design is 50% complete, which is equivalent to 20% of the total design work. Thus design is 80% complete (60% for preliminary design plus 20% for final design.) The submittals are being made and approved on schedule. Any delays to the tunnel and station access dates affect the installation schedules. Procurement schedules can be maintained if storage is advantageous.

CASE	COMPLETE AR CABLE	DAYS	COMPLETE AL CABLE	DAYS	CONTRACT COMPLETION	DAYS
Current Contract	23 Nov 90		04 Dec 90		12 Feb 92	
REV 6D	29 Jul 91		23 Aug 91		16 Jul 92	
OPTIMISTIC	11 Nov 91	95	01 Nov 91	70	15 Aug 92	30
PESSIMISTIC	01 Aug 92	372	01 Aug 92	347	12 Jul 93	361
PROBABLE	15 Apr 92	261	15 Apr 92	236	05 Jan 93	173

Note: Days are calendar day variance from the Rev 6D schedule.

Assumptions

Optimistic

1. Based on optimistic A610 and facility access dates.
2. No crewing constraints. Work at the stations could overlap as shown in the approved schedule.
3. All the station access dates contain 3 months of contingency. However, due to the tunnel work tie to the critical path of the project, additional float exists in the station activities related to A620 contract work.

Pessimistic

1. Based on pessimistic A610 and Facility access dates.
2. No crewing constraints, but crewing constraints would not impact schedule.
3. Some rewiring and rework for variations between contract documents and existing conditions.
4. Some periods of interference with other contractors and delays in providing power
5. The above conditions result in a 30% loss of productivity, increasing the durations by 30%.

Probable

1. Based on probable A610 and Facility access dates.
2. Installation durations begin at point when both the AR and AL tunnels are available.
3. 2 crew limitation.

Contract A631, Traction Power Installation

Contract A630 includes design and procurement and is underway. Contract A631 includes installation, and is in the bidding stage. Any delays to the tunnel and station access dates affect the installation schedules. Progress is slightly behind on A630, but is being recovered and has no impact.

Assumptions

1. No unique problems to contract.

2. Schedule driven by Other Facility and Systems contracts, not A631.
3. Start of work in any area is triggered 3 months after A620 begins work.
4. This work is not on the critical path. No potential impacts, even under pessimistic assumptions would impact program schedule dates.

Contract A640, Communications

Design work is proceeding on schedule towards a revised design completion date in January 1990. This revision is in the change approval process and has no negative impact on the program schedule. Submittals and reviews are taking place in accordance with the revised schedule. Any delays to the tunnel and station access dates affect the installation schedules.

Assumptions

Optimistic

1. Based on optimistic access dates.
2. Durations based on Rev. 6D.

Pessimistic

1. Based on pessimistic access dates.
2. Problems with SCADA testing and interferences with other contractors cause a 30% loss of productivity, resulting in a 30% increase in the time for completion of SCADA testing.

Probable

1. Based on probable access dates.
2. Durations per contractor schedule submittal.
3. Based on a staggered start with A620 and coordinated scheduling of tunnel access.

Contract A650, Passenger Vehicles

Contractor submittals are 2 months behind schedule, but improving. The current delays are not expected to have any impact on the final design or manufacturing schedules.

Assumptions

General

1. Pacing item to schedule is delivery of first pair of cars for testing.
2. Cannot complete testing in tunnels until permanent power and radio communications are available.

Optimistic

Current approved schedule with delivery of first pair to Los Angeles by 1 July 1991, which is 10 months before permanent power would be available and 13 months before radio communications would be available, both of which are necessary for testing.

Pessimistic

Potential problems with propulsion subcontractor could lead to delay of 6 months (delivery of 1st pair by 01 Jan 92), which would still be 7 months in advance of tunnel availability for testing.

Probable

Potential problems with propulsion subcontractor would lead to 3 months delay (delivery of 1st pair by 01 Oct 91), which would be 10 months in advance of tunnel availability for testing.

POTENTIAL REVISIONS TO SCHEDULE LOGIC

There are additional changes that could be made to the MOS-1 schedule by overlapping or changing the sequence of work that would accelerate work at a cost. These changes are not normally included in a program plan, but represent changes that could be made at a later date, if necessary and cost effective, to maintain the milestone dates. These changes are useful to include because they indicate a form of contingency within the schedule and thus help determine the flexibility of the schedule to accommodate future unanticipated schedule delays. It is not recommended that these changes be included in the schedule now.

Trackwork access is the most critical aspect of this schedule. Accordingly four logic change options were explored that could potentially improve the time to perform work in the tunnels, including subsequent testing operations. These four are:

- Option 1. Allow the A620 contractor into the tunnel after A610 completes the concrete pours, but prior to laying the trackwork.
- Option 2. Separate the trackwork installation between AL and AR and overlap A610 coverboard installation with A620 cable installation.
- Option 3. Overlap System Modification with Safe Braking and Dynamic testing.
- Option 4. Provide early access to the AR track area before the AL track area (or a combination of AL and AR leading to a complete line from portal to Wilshire Alvarado.

Neither of these items alone achieves a significant time reduction. However, a combination of Options 3 and 4 produce a net savings of 3 months.

Analysis of Options

1. Early tunnel access by A620

In the current probable schedule the A620 Contractor does not lay cables until A610 has completed laying the trackwork. The schedule could be revised to allow A620 into the tunnel immediately after A610 completes the tunnel track work, which would reduce the remaining A620 schedule by 1 month, allowing A640 work to start 1 1/2 months earlier and Systems Testing to start 1 month earlier. The net schedule savings would be 1 month.

2. Separate AL/AR trackwork and overlap A610 coverboard installation with A620 cable installation.

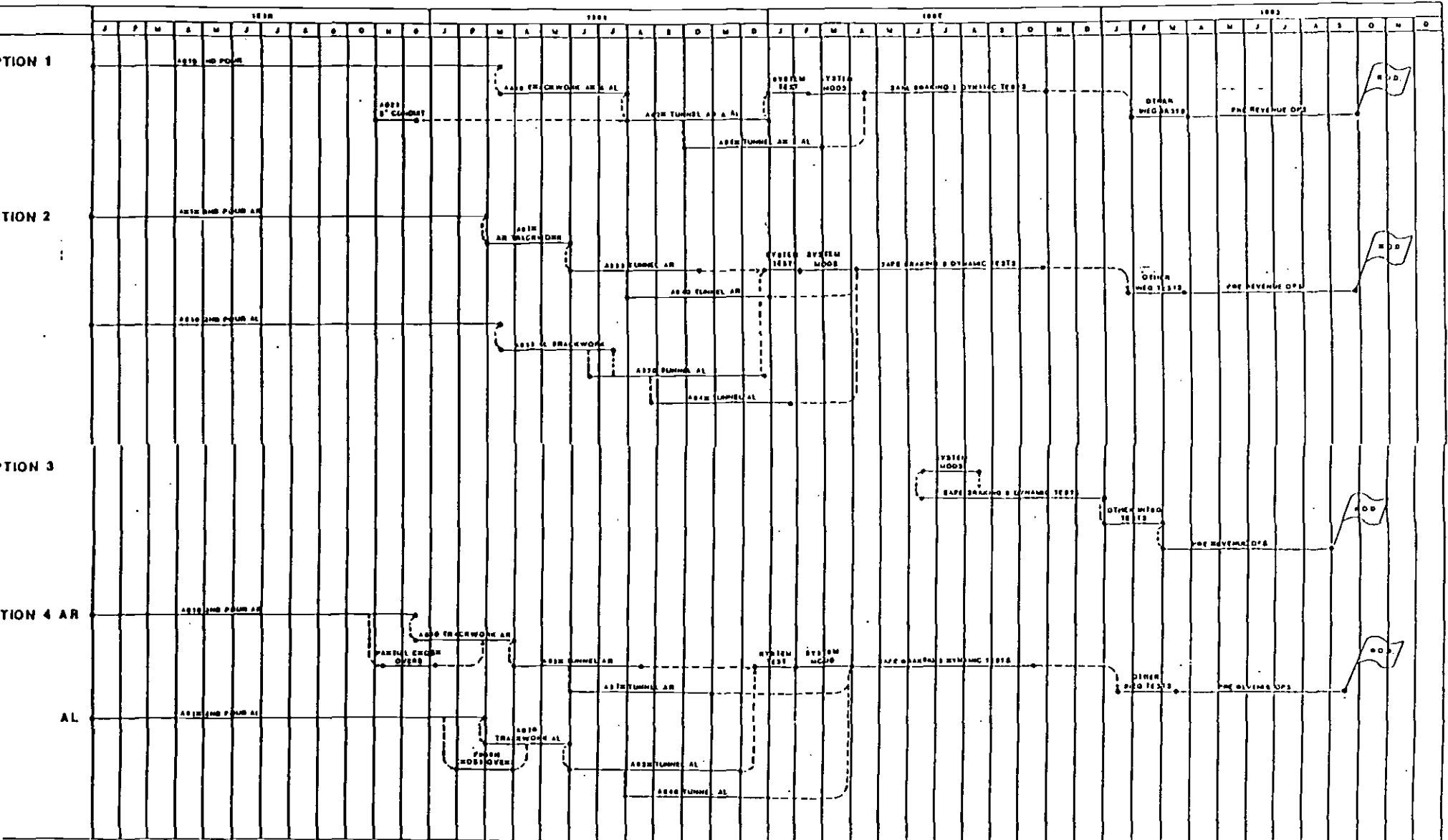
This option combines 2 changes. The first requests A610 to concentrate on completing the AR tunnel before AL, which saves 2 weeks. The second allows A620 to begin work in the AR and AL tunnels after the coverboard is laid, rather than waiting for completion of A610 work, which would potentially save another 3 weeks. The net savings would be 5 weeks and require change orders to A610 and A620.

3. Overlap System Modification with Safe Braking and Dynamic testing.

The current schedule shows Systems Modifications and Safebraking/Dynamic Testing as consecutive activities. This potential change would overlap the start of both activities and save 2 months. No change order is required.

4. Early access to AR tunnel

This potential change would fully separate the trackwork in the AR and AL tunnels. Access to the AR tunnel could be made 3 months into the A610 work, which would result in a 2 months savings in the completion of A620 work, thus allowing A640 into the tunnels 2 months earlier. The stations would become the controlling factor, however, and the net savings would be 1 month. Change orders would be necessary for A610 and A620.



REV	DATE	DESCRIPTION	APPROVED	DATE

JOB NO.	DOCUMENT NO.


SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

TITLE: _____

REV: _____

REV	DATE	DESCRIPTION	APPROVED	DATE

JOB NO.	DOCUMENT NO.


SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

TITLE: _____

REV: _____

**EXHIBIT IV-9
CASE III - PROBABLE
SCHEDULE ANALYSIS
SOUTHERN CALIFORNIA
RAPID TRANSIT DISTRICT**

PROPOSED ROD DATE EXTENSION

CASE III PROBABLE SCHEDULE

METRO-RAIL M05-1

DATE: 3/20/89

Months (NOT PRINTED) - Contractor RESPONSIBILITY X Rev 60 NEGATIVE EARLY
ESCALATION INCREASE WHEN X UNAPPLIED
Down in Interest Months X Rev 60

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL	UNEXPENDE	REVISION 60	PROPOSED	ESCALATION MDPT	ESCALATION FACTOR	CONTRACT DURATION	SCHEDULE	CONTRACT	CONTRACT	PROPOSED	PROPOSED									
		REV 60	REV 60	CONTRACT	CONTRACT	NIP	COMPLETION	NIP	COMPLETION	REV	PRO-	INCR	REV	PRO-	INCR	REV	PRO-	INCR	EXTENH	OVERHDS	CAUSED	TTL CONTR
FORECAST	FORECAST	DATE	DATE	DATE	DATE	DATE	60	POSED	DEC	60	POSED	DEC	60	POSED	DEC	ESCALATI	PRORATES	DELAYS	FORECAST	REV 60		
4A130	YARD LEADS AND TRANSFER ZONE	36,179	32,203	01-Jul-80	00-Jun-90	01-Jul-80	15-Feb-91	42	46	4	1.148	1.163	0.015	23	32	9	483	4,955	(3,303)	38,314	2,135	
NA-007	YARD/SHOPS TELEPHONE RELOCATION	90	90	01-Jul-80	00-Jun-90	01-Jul-80	15-Feb-91	42	46	4	1.148	1.163	0.015	23	32	9	0	0	0	90	0	
NA-093	YARD/SHOPS GAS RELOCATION	530	510	01-Jul-80	00-Jun-90	01-Jul-80	15-Feb-91	42	46	4	1.148	1.163	0.015	23	32	9	0	0	0	530	0	
NA-009	YARD/SHOPS WATER RELOCATION	238	238	01-Jul-80	00-Jun-90	01-Jul-80	15-Feb-91	42	46	4	1.148	1.163	0.015	23	32	9	0	0	0	238	0	
NA-009	YARD/SHOPS POWER RELOCATION	60	60	01-Jul-80	00-Jun-90	01-Jul-80	15-Feb-91	42	46	4	1.148	1.163	0.015	23	32	9	0	0	0	60	0	
NA-545	YARD/SHOPS CHEVRON RELOCATION	90	90	01-Jul-80	00-Jun-90	01-Jul-80	15-Feb-91	42	46	4	1.148	1.163	0.015	23	32	9	0	0	0	90	0	
NA-056	YARD/SHOPS CALTRANS	111	101	01-Jul-80	00-Jun-90	01-Jul-80	15-Feb-91	42	46	4	1.148	1.163	0.015	23	32	9	0	0	0	111	0	
NA-008	YARD/SHOPS WESTERN UNION REPLACEMENT	5	5	01-Jul-80	00-Jun-90	01-Jul-80	15-Feb-91	42	46	4	1.148	1.163	0.015	23	32	9	0	0	0	5	0	
TOTAL CONTRACT A130		37303	33297					42	46	4	1.148	1.163	0.015	23	32	9	0	4,955	(3,303)	39,438	2,135	

From Rev. of 1989 DRAFT
Rev 60 (Dm. CAS) / Rev 60
Rev 60
Proposed Months 60
Example Proposed Months Rev 60
Proposed Months 60
Proposed Total Months 60

PROPOSED ROD DATE EXTENSION

CASE III PROBABLE SCHEDULE

METRO-RAIL NOS-1

DATE: 3/20/89

CASE III SHEET 2 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL	UNEXPENDE	REVISION 60	PROPOSED	ESCALATION	NOPI	ESCALATION	FACTOR	CONTRACT	DURATION	SCHEDULE	CONTRACT	CONTRACT	PROPOSED	PROPOSED					
		REV 60	REV 60	DATE	DATE	DATE	DATE	60	POSED	DEC	60	POSED	DEC	60	POSED	DEC	COST	PRORATES	DELAYS	FORECAST	REV 60
NA133	UNION STATION-STAGE I	65164	59248	11-Jul-88	29-Apr-91	11-Jul-88	29-Aug-91	47	49	2	1.167	1.175	0.008	34	38	4	474	2,683	0	68,321	3,157
NA-007	UNION STATION TELEPHONE RELOCATION	30	30	11-Jul-88	29-Apr-91	11-Jul-88	29-Aug-91	47	49	2	1.167	1.175	0.008	34	38	4	0	0	0	30	0
NA-AD9	UNION STATION WATER RELOCATION	50	50	11-Jul-88	29-Apr-91	11-Jul-88	29-Aug-91	47	49	2	1.167	1.175	0.008	34	38	4	0	0	0	50	0
NA-009	UNION STATION POWER RELOCATION	150	150	11-Jul-88	29-Apr-91	11-Jul-88	29-Aug-91	47	49	2	1.167	1.175	0.008	34	38	4	0	0	0	150	0
NA-056	UNION STATION CALTRANS	50	40	11-Jul-88	29-Apr-91	11-Jul-88	29-Aug-91	47	49	2	1.167	1.175	0.008	34	38	4	0	0	0	50	0
TOTAL CONTRACT NA133		65449	59523					47	49	2	1.167	1.175	0.008	34	38	4	474	2,683	0	68,606	3,157

*Contract NA133
29-Jul-91*

PROPOSED R0D DATE EXTENSION

CASE III PROBABLE SCHEDULE

METRO-RAIL NOS-1

DATE: 3/20/89

CASE III SHEET 3 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL	UNEXPENDE	REVISION 60	PROPOSED	ESCALATION HDPI	ESCALATION FACTOR	CONTRACT DURATION	SCHEDULE	CONTRACT	CONTRACT	PROPOSED	PROPOSED								
		REV 60	REV 60	DATE	DATE	REV	INCR	REV	PRO	INCR	EXTEN	OVERHOS	CAUSED	CONTR	INCR						
*A141	UNION STA/SIH HILL W CIVIC CNTR STA	73340	38494	16-Mar-87	08-Aug-90	16-Mar-87	01-Mar-91	35	38	3	1.122	1.133	0.011	41	48	7	423	4,383	(4,383)	73,771	423
NA-008	CIVIC CENTER WESTERN UNION REPLACEME	5	5	28-Aug-87	08-Aug-90	28-Aug-87	01-Mar-91	38	41	3	1.133	1.144	0.011	35	42	7	0	0	0	5	0
NA-A09	CIVIC CENTER WATER RELOCATION	580	280	15-Dec-86	08-Aug-90	15-Dec-86	01-Mar-91	33	37	4	1.114	1.129	0.015	44	51	7	0	0	0	580	0
NA-009	CIVIC CENTER POWER RELOCATION	270	270	16-Sep-86	08-Aug-90	16-Sep-86	01-Mar-91	32	35	3	1.111	1.122	0.011	47	53	6	0	0	0	270	0
NA-007	CIVIC CENTER TELEPHONE RELOCATION	1460	1460	20-Oct-86	08-Aug-90	20-Oct-86	01-Mar-91	32	36	4	1.111	1.125	0.014	46	52	6	0	0	0	1,460	0
NA-093	CIVIC CENTER GAS RELOCATON	75	55	16-Sep-86	08-Aug-90	16-Sep-86	01-Mar-91	32	35	3	1.111	1.122	0.011	47	53	6	0	0	0	75	0
NA-533	CIVIC CENTER CABLE TV RELOCATION	5	5	28-Aug-87	08-Aug-90	28-Aug-87	01-Mar-91	38	41	3	1.133	1.144	0.011	35	42	7	0	0	0	5	0
NA-056	CIVIC CENTER CALTRANS	45	35	20-Jan-88	08-Aug-90	20-Jan-88	01-Mar-91	40	43	3	1.140	1.152	0.012	31	37	6	0	0	0	45	0
TOTAL CONTRACT A141		75788	40604					35	38.2	3.25	1.121	1.133	0.012	40	47.2	6.5	423	4,383	(4,383)	76,211	423

PROPOSED ROD DATE EXTENSION

CASE III PROBABLE SCHEDULE

METRO-RATE MOS-1

DATE: 3/20/89

CASE III SHEET 4 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL	UNEXPENDE	REVISION 6D	PROPOSED	ESCALATION MDPT	ESCALATION FACTOR	CONTRACT DURATION	SCHEDULE	CONTRACT	CONTRACT	PROPOSED	PROPOSED								
		REV 6D	REV 6D	COMPLETION DATE	COMPLETION DATE	REV 6D	PROPOSED	DEC	REV 6D	PROPOSED	DEC	COST	PRORATES	DELAYS	FORECAST	REV 6D					
*A145	STN & HILL STATION - STAGE I	47040	30868	02-Apr-87	20-Aug-90	02-Apr-87	01-Feb-91	35	38	3	1.122	1.133	0.011	41	46	5	340	2,008	(803)	48,584	1,544
MA-008	5th/HILL WESTERN UNION REPLACEMENT	25	25	02-Apr-87	20-Aug-90	02-Apr-87	01-Feb-91	35	38	3	1.122	1.133	0.011	41	46	5	0	0	0	25	0
MA-A09	5th/HILL WATER RELOCATION	570	470	08-Sep-87	20-Aug-90	08-Sep-87	01-Feb-91	38	41	3	1.133	1.144	0.011	35	41	6	0	0	0	570	0
MA-009	5th/HILL POWER RELOCATION	1420	848	16-Sep-86	20-Aug-90	16-Sep-86	01-Feb-91	32	35	3	1.111	1.122	0.011	47	53	6	0	0	0	1,420	0
MA-007	5th/HILL TELEPHONE RELOCATION	540	340	07-Oct-86	20-Aug-90	07-Oct-86	01-Feb-91	32	35	3	1.111	1.122	0.011	46	52	6	0	0	0	540	0
MA-093	5th/HILL GAS RELOCATION	150	130	02-Sep-87	20-Aug-90	02-Sep-87	01-Feb-91	38	41	3	1.133	1.144	0.011	36	41	5	0	0	0	150	0
MA-533	5th/HILL CABLE TV REPLACEMENT	5	5	31-Aug-87	20-Aug-90	31-Aug-87	01-Feb-91	38	41	3	1.133	1.144	0.011	36	41	5	0	0	0	5	0
TOTAL CONTRACT A145		49750	32686					35	38	3	1.123	1.133	0.011	40	46	5	340	2,008	(803)	51,294	1,544

PROPOSED RUD DATE EXTENSION

CASE III PROBABLE SCHEDULE

METRO-RAIL M05-1

DATE: 3/20/89

CASE III SHEET 5 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL	UNEXPENDE	REVISION 60	PROPOSED	ESCALATION NDPI	ESCALATION FACTOR	CONTRACT DURATION	SCHEDULE	CONTRACT	CONTRACT	PROPOSED	PROPOSED								
		REV 60	REV 60	DATE	DATE	REV	INCR	REV	INCR	REV	INCR	EXTENT	OVERHDS	CAUSED	CONTR	INCR					
*A146	LINE-5th/HILL STA. TO 71st/FLOWER STA.	20021	11148	06-Apr-87	30-Mar-90	06-Apr-87	15-Sep-90	33	36	3	1.114	1.125	0.011	36	41	5	123	973	(973)	20,144	123
*A165	71st/FLOWER STATION - STAGE 1	47326	35226	05-Jan-88	20-Sep-90	05-Jan-88	26-Dec-90	40	42	2	1.140	1.148	0.008	33	36	3	282	1,506	(1,004)	48,110	784
MA-008	71st/FLOWER WESTERN UNION REPLACEMENT	80	80	24-Apr-87	28-Sep-90	24-Apr-87	26-Dec-90	36	38	2	1.125	1.133	0.008	41	44	3	0	0	0	80	0
MA-A09	71st/FLOWER WATER RELOCATION	1330	896	07-Oct-87	28-Sep-90	07-Oct-87	26-Dec-90	39	41	2	1.137	1.144	0.007	36	39	3	0	0	0	1,330	0
MA-009	71st/FLOWER POWER RELOCATION	514	514	15-Dec-86	28-Sep-90	15-Dec-86	26-Dec-90	34	36	2	1.118	1.125	0.007	45	48	3	0	0	0	514	0
MA-007	71st/FLOWER TELEPHONE RELOCATION	890	474	02-Feb-87	28-Sep-90	02-Feb-87	26-Dec-90	35	36	1	1.122	1.125	0.003	44	47	3	0	0	0	890	0
MA-093	71st/FLOWER GAS RELOCATION	313	306	17-Sep-87	28-Sep-90	17-Sep-87	26-Dec-90	39	40	1	1.137	1.140	0.003	36	39	3	0	0	0	313	0
MA-533	71st/FLOWER CABLE TV RELOCATION	55	35	06-Jul-87	28-Feb-90	06-Jul-87	26-Dec-90	34	39	5	1.118	1.137	0.019	32	42	10	0	0	0	55	0
TOTAL CONTRACT A165		50508	37531					37	39	2.14	1.128	1.137	0.0078	38	42	4	282	1,506	(1,004)	51,292	784
*A171	LINE-71st/FLOWER STATION 10	26711	11557	02-Feb-87	27-Nov-89	02-Feb-87	27-Nov-89	30	30	0	1.103	1.103	0.000	34	34	0	0	0	0	26,711	0

PROPOSED RUD DATE EXTENSION

CASE III PROBABLE SCHEDULE

METRO-RAIL MOS-1

DATE: 3/20/89

CASE III SHEET 3 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL	UNEXPENDE	REVISION 60	PROPOSED	ESCALATION MDP1	ESCALATION FACTOR	CONTRC DURATION	SCHEDULE	CONTRACT	CONTRACTO	PROPOSED	PROPOSED									
		REV 60	REV 60	CONTRACT	CONTRACT	INP	COMPLETION	INP	COMPLETION	REV	PRO	INCR	REV	PRO	INCR	EXTENIN	OVERHOS	CAUSED	TTL CONTR	INCR		
		FORECAST	FORECAST	DATE	DATE	DATE	DATE	DATE	60	POSED	DEC	60	POSED	DEC	60	POSED	DEC	COST	PRORATES	DELAYS	FORECAST	REV 60
*A175	WILSHIRE/ALVARADO STATION - STAGE I	24533	24466	27-Jul-87	12-Jul-90	27-Jul-87	05-Aug-90	37	37	0	1.129	1.129	0.000	36	36	0	0	0	0	0	24,533	0
MA-A09	WILSHIRE/ALVARADO WATER RELOCATION	200	200	04-Sep-87	12-Jul-90	04-Sep-87	05-Aug-90	37	38	1	1.129	1.133	0.004	34	35	1	0	0	0	0	200	0
MA-009	WILSHIRE/ALVARADO POWER RELOCATION	30	30	04-Sep-87	12-Jul-90	04-Sep-87	05-Aug-90	37	38	1	1.129	1.133	0.004	34	35	1	0	0	0	0	30	0
MA-007	WILSHIRE/ALVARADO TELEPHONE RELOCATI	80	80	04-Sep-87	12-Jul-90	04-Sep-87	05-Aug-90	37	38	1	1.129	1.133	0.004	34	35	1	0	0	0	0	80	0
MA-093	WILSHIRE/ALVARADO GAS RELOCATION	50	50	04-Sep-87	12-Jul-90	04-Sep-87	05-Aug-90	37	38	1	1.129	1.133	0.004	34	35	1	0	0	0	0	50	0
MA-056	WILSHIRE/ALVARADO CALTRANS	54	41	22-Oct-87	12-Jul-90	22-Oct-87	05-Aug-90	38	38	0	1.133	1.133	0.000	33	33	0	0	0	0	0	54	0
MA-533	WILSHIRE/ALVARADO CABLE TV RELOCATIO	35	22	04-Sep-87	12-Jul-90	04-Sep-87	05-Aug-90	37	38	1	1.129	1.133	0.004	34	35	1	0	0	0	0	35	0
TOTAL CONTRACT A175		24982	24889					37	38	0.71	1.129	1.133	0.0028	34	35	1	0	0	0	0	24,982	0

PROPOSED RFD DATE EXTENSION

CASE III PROBABLE SCHEDULE

MEIRO-RAIL MOS-1

DATE: 3/20/89

CASE III SHEET 6 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL REV 6D	UNEXPENDE REV 6D	REVISION 6D DATE	PROPOSED COMPLETION DATE	ESCALATION MDPI	ESCALATION FACTOR	CONTRACT DURATION	SCHEDULE	CONTRACT	CONTRACT	PROPOSED	PROPOSED								
NUMBER	DESCRIPTION	FORECAST	FORECAST	DATE	DATE	REV 6D	POSED DEC	6D	POSED DEC	6D	POSED DEC	COST	PRORATES	DELAYS	FORECAST	REV 6D					
STAGE II CONTRACTS																					
A136	UNION STATION - STAGE II	9434	9434	05-Jan-90	16-Aug-91	07-Sep-90	15-Apr-92	58	66	8	1.210	1.242	0.032	19	19	0	302	0	0	9,736	302
A147	CIVIC CENTER STATION - STAGE II	10886	10886	29-Jan-90	01-Oct-91	01-Jul-90	01-Feb-92	59	64	5	1.214	1.234	0.020	20	19	(1)	218	0	0	11,104	218
A157	5th/HILL STATION - STAGE II	11134	11134	07-Nov-89	01-Oct-91	15-May-90	15-Apr-92	58	64	6	1.210	1.234	0.024	23	23	0	267	0	0	11,401	267
A167	7th/FLOWER STATION - STAGE II	12385	12385	10-Apr-89	03-Jul-91	10-Apr-89	03-Oct-91	53	54	1	1.190	1.194	0.004	27	30	3	50	0	0	12,435	50
A187	MILSHIRE/ALVARADO STATION - STAGE II	7379	7379	30-Nov-89	01-Feb-90	01-Feb-90	01-Oct-91	48	59	11	1.210	1.214	0.004	2	20	18	30	0	0	7,409	30
TOTAL STAGE II CONTRACTS		51218	51218					55	61	6	1.206	1.223	0.0168	18	22	4	866	0	0	52,084	866

Compare ROW III - STAGE II DATES - A

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PROPOSED RPD DATE EXTENSION

CASE III PROBABLE SCHEDULE

METRO-RAIL NOS-1

DATE: 3/20/89

CASE III SHEET 7 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL	UNEXPENDE	REVISION 6D	PROPOSED	ESCALATION MDPI	ESCALATION FACTOR	CONTRACT DURATION	SCHEDULE	CONTRACT	CONTRACT	PROPOSED	PROPOSED								
		REV 6D	REV 6D	COMPLETION DATE	COMPLETION DATE	REV PRO	INCR	REV PRO	INCR	EXTENM	OVERHDS	CAUSED	TTL CONTR	INCR							
		FORECAST	FORECAST	DATE	DATE	POSED	DEC	POSED	DEC	POSED	DEC	COST	PRORATES	DELAYS	FORECAST	REV 6D					
SYSTEMS CONTRACTS																					
0610/A115	TRACWORK INSTALLATION	23617	14700	04-Jan-88	11-Jan-91	04-Jan-88	15-Oct-91	42	47	5	1.140	1.167	0.019	36	45	9	279	1,827	0	25,723	2,106
0620	AUTOMATIC TRAIN CONTROL PROCURE/INSI	11599	11203	01-Mar-88	16-Jul-92	01-Mar-88	01-May-93	52	57	5	1.186	1.206	0.020	53	62	9	224	927	0	12,750	1,151
0631	TRACILON POWER EQUIPMENT INSTALLATIO	6281	6281	13-Apr-89	11-Oct-91	13-Apr-89	01-Aug-92	54	59	5	1.194	1.234	0.040	30	40	10	251	1,090	0	7,622	1,341
0640	COMMUNICATIONS PROCURE/INSTALL	35998	32699	07-Jul-88	16-Jul-92	07-Jul-88	01-May-93	54	59	5	1.194	1.214	0.020	48	58	10	654	4,990	0	41,642	5,644
TOTAL STAGE II CONTRACTS		77495	64883				50.5	56	5	1.180	1.206	0.0247	41	51.2	9.5	1,409	8,834	0	87,738	10,243	
TOTAL CONTRACTS..PROBABLE CASE																					
		479,225	367,336														2,916	25,342	(10,467)	478,499	19,274
																	3679	2900	496,924	17,696	

EXHIBIT J O
EXPLANATION OF CASE III
PROBABLE SCHEDULE ANALYSIS
METHODOLOGY

SOUTHERN CALIFORNIA
RAPID TRANSIT DISTRICT

PROPOSED RFD DATE EXTENSION
METRO-RAIL NOS-1
DATE: 3/20/89

CASE III PROBABLE SCHEDULE

CASE III SHEET 1 OF 6

CONTRACT NUMBER	CONTRACT DESCRIPTION	TOTAL REV 60 CONTRACT FORECAST	UNEXPENDE REV 60 CONTRACT FORECAST	REVISION 60		PROPOSED		ESCALATION MIDPOINT			ESCALATION FACTOR			CONTRACT DURATION			SCHEDULE EXISTING ESCALATION	CONTRACT OVERHEADS PRORATED	CONTRACT CAUSID DELAYS	PROPOSED IIR CONIR FORECAST	PROPOSED INCR. 1/- REV 60
				NTP DATE	COMPLETION DATE	NTP DATE	COMPLETION DATE	REV 60	PROPOSED	INC/DEC	REV 60	PROPOSED	INC/DEC	REV 60	PROPOSED	INC/DEC					
*A130	YARD LEADS AND TRANSFER ZONE	36,179	32,203	01-Jul-88	08-Jun-90	01-Jul-88	15-Feb-91	42	46	4	1.140	1.163	0.015	23	32	9	483	4,955	(3,303)	38,314	2,135
		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑳	

- 1.) CONTRACT VALUE PER REV 60 FINANCIAL PLAN
- 2.) CONTRACT VALUE FROM REV 60 LESS EXPENDITURE PER RTO MONTHLY STATUS REPORT Dec '88
- 3.) NTP AS OF REVISION 60 FINANCIAL PLAN SUPPLIED BY SCHEDULING
- 4.) COMPLETION AS OF REV 60 FROM SCHEDULING
- 5.) PROPOSED RFD - EXTENSION RFD SCHEDULE SUPPLIED BY SCHEDULING (PROJECT SCHED. EVALUATION, 2 SUPPLEMENTS)
- 6.) PROPOSED COMPLETION DATE FROM SCHEDULING (SAME SOURCES)
- 7.) MIDPOINT ESCALATION FROM REVISION 60. (P.C. FORMULA) $(\text{COMPLETION} - \text{NTP} \div 2)$ ADDED TO Dec. 85. STAT
- 8.) MIDPOINT ESCALATION BASED ON PROPOSED DATES - SAME FORMULA AS ITEM 7.
- 9.) PROPOSED MIDPOINT - ITEM 8 MINUS 60 MIDPOINT ITEM 7.
- 10.) ESCALATION FACTOR FROM RTO - DEVELOPED SCHEDULE OF ESCALATION FACTORS APPLIED REV 60 MIDPOINT
- 11.) ESCALATION FACTOR APPLIED TO PROPOSED MIDPOINT
- 12.) ~~REV 60 ESCALATION~~ PROPOSED ESCALATION LESS REV 60 ESCALATION
- 13.) ITEM 4 LESS ITEM 3
- 14.) ITEM 6 LESS ITEM 5
- 15.) ITEM 14 LESS ITEM 13
- 16.) ITEM 12 X ITEM 2
- 17.) $(\text{ITEM 1} \times .35) \div \text{ITEM 13} \dots \text{REV 60 DURATION} \times \text{ITEM 15} \dots \text{INCREASED DURATION} = 4955$
- 18.) 6 MONTHS DETERMINED TO BE FRACTION OF THE CONTRACTOR ... $550.5 \times 6 = (3303)$
- 19.) ITEM 1 + ITEM 16 + ITEM 17 + ITEM 18 ... $36179 + 483 + 4955 + (3303) = 38314$
- 20.) ITEM 19 LESS ...

EXHIBIT IV - II
APPLICATION OF MRT FACTORS
TO LINE ITEMS
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

CONTRACT	CONTRACT DESCRIPTION	MRT	POTENTIAL CHANGE LOG		SCHEDULE REVISIONS		CLAIMS		UNBOOKED CHANGES & CLAIMS	
			TOTAL	MRT	TOTAL	MRT	TOTAL	MRT	CLAIMS	MRT
A112	MAIN SHOP BUILDING	100 %	120,000	120,000	60,000	60,000	3,000,000	3,000,000	1,000,000	1,000,000
A121	MOW BUILDING	100 %	40,000	40,000	0	0	40,000	40,000	0	0
*A123	DEMO WEST TRANSKO BUILDING	100 %	0	0	0	0	0	0	0	0
A130	YARD AND YARD LEADS	100 %	300,000	300,000	4,255,000	4,255,000	1,400,000	1,400,000	1,000,000	1,000,000
*A134	DEMO STRUCTURE ON PARCEL A1-032	100 %	0	0	0	0	0	0	0	0
A135	UNION STATION, STAGE I	100 %	3,692,427	3,692,427	1,105,000	1,105,000	568,366	568,366	2,000,000	2,000,000
*A137	SOUTHERN PACIFIC COM. RELOCATE	100 %	0	0	0	0	0	0	0	0
A141	LINE-U.S. TO 5TH/HILL STA CIVIC CENTER STATION-STAGE I	100 %	8,000,000	8,000,000	423,000	423,000	1,500,000	1,500,000	3,000,000	3,000,000
A143	PROCURE WATER TREAT CHEMICALS	100 %	0	0	0	0	0	0	1,000,000	1,000,000
A144	MTR TRTMT PLANT OPERATIONS	100 %	20,000	20,000	0	0	0	0	0	0
A145	5TH/HILL STA, STAGE I	100 %	1,168,631	1,168,631	1,544,000	1,544,000	2,000,000	2,000,000	2,000,000	2,000,000
A146	LINE-5TH/HILL STA TO 7TH/FLWR S	100 %	183,034	183,034	1,123,000	1,123,000	2,000,000	2,000,000	2,000,000	2,000,000
*A161	7TH/FLWR UTILITY REARRANGE	46 %	0	0	0	0	0	0	0	0
A165	7TH/FLWR STA, STAGE I	100 %	2,000,000	2,000,000	784,000	784,000	0	0	4,000,000	4,000,000
A167	7TH/FLWR STA, STAGE II	68 %	20,000	13,600	50,000	34,000	50,000	34,000	0	0
A171	LINE-7TH/FLWR TO WILSHIRE/ALV	100 %	50,000	50,000	292,000	292,000	200,000	200,000	500,000	500,000
*A172	DEMO STRUCT ON PARCEL A1-208	100 %	0	0	0	0	0	0	0	0
*A173	DEMO OF PARCELS A1-221,222,224,	100 %	0	0	0	0	0	0	0	0
A175	WILSHIRE/ALVARDO STA, STAGE I	100 %	91,223	91,223	0	0	2,000,000	2,000,000	1,000,000	1,000,000
A610/11	TRACKWORK INSTALLATION	100 %	892,472	892,472	3,106,000	3,106,000	2,000,000	2,000,000	1,000,000	1,000,000
A612	CONTRACT RAIL PROCUREMENT	100 %	0	0	0	0	0	0	0	0
A615	PROTECTIVE COVERBOARD PROCUREME	100 %	0	0	0	0	0	0	0	0
A616	RAIL FASTENERS PROCUREMENT	28 %	0	0	0	0	0	0	0	0
A620	AUTO TRAIN CONTROL/PROCURE	100 %	(2,193)	(2,193)	1,951,000	1,951,000	0	0	200,000	200,000
A630	TRACTION POWER EQUIP PROCURE	93 %	0	0	0	0	0	0	0	0
A631	TRACTION POWER INSTALLATION	98 %	0	0	1,341,000	1,314,180	0	0	400,000	392,000
A640	COMMUNICATIONS/PROCURE	96 %	3,572,210	3,429,322	5,644,000	5,418,240	0	0	3,000,000	2,880,000
A650	PASSENGER VEHICLES PROCURE	100 %	0	0	0	0	0	0	0	0
A710	ESCALATORS/PROCURE/INSTALL	93 %	38,100	35,433	0	0	0	0	200,000	186,000
A732	WHEEL TRUING MACHINE	100 %	0	0	0	0	0	0	0	0
A740	VENTILATION EQUIP PROCURE	79 %	0	0	0	0	0	0	100,000	79,000
A745	TPSS-AIR HANDLE EQUIP/PROCURE	100 %	0	0	0	0	0	0	0	0
A750	HAZ MAT DISPOSAL	100 %	0	0	0	0	0	0	0	0
A795	UNINTERRUPT POW SUPPLY- 50kva	91 %	0	0	0	0	0	0	0	0
A796	UNINTERRUPT POW SUPPLY-100kva	100 %	0	0	0	0	0	0	0	0
H840	FARE COLLECTION	100 %	0	0	0	0	0	0	0	0
4239	TELEPHONE EQUIPMENT	100 %	0	0	0	0	0	0	0	0
TOTALS			\$20,185,904	\$20,033,949	\$21,678,000	\$21,409,420	\$14,758,366	\$14,742,366	\$22,400,000	\$22,237,000

EXHIBIT IV-12
 ALLOWANCES ASSOCIATED WITH
 AWARDED CONTRACTS
 SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

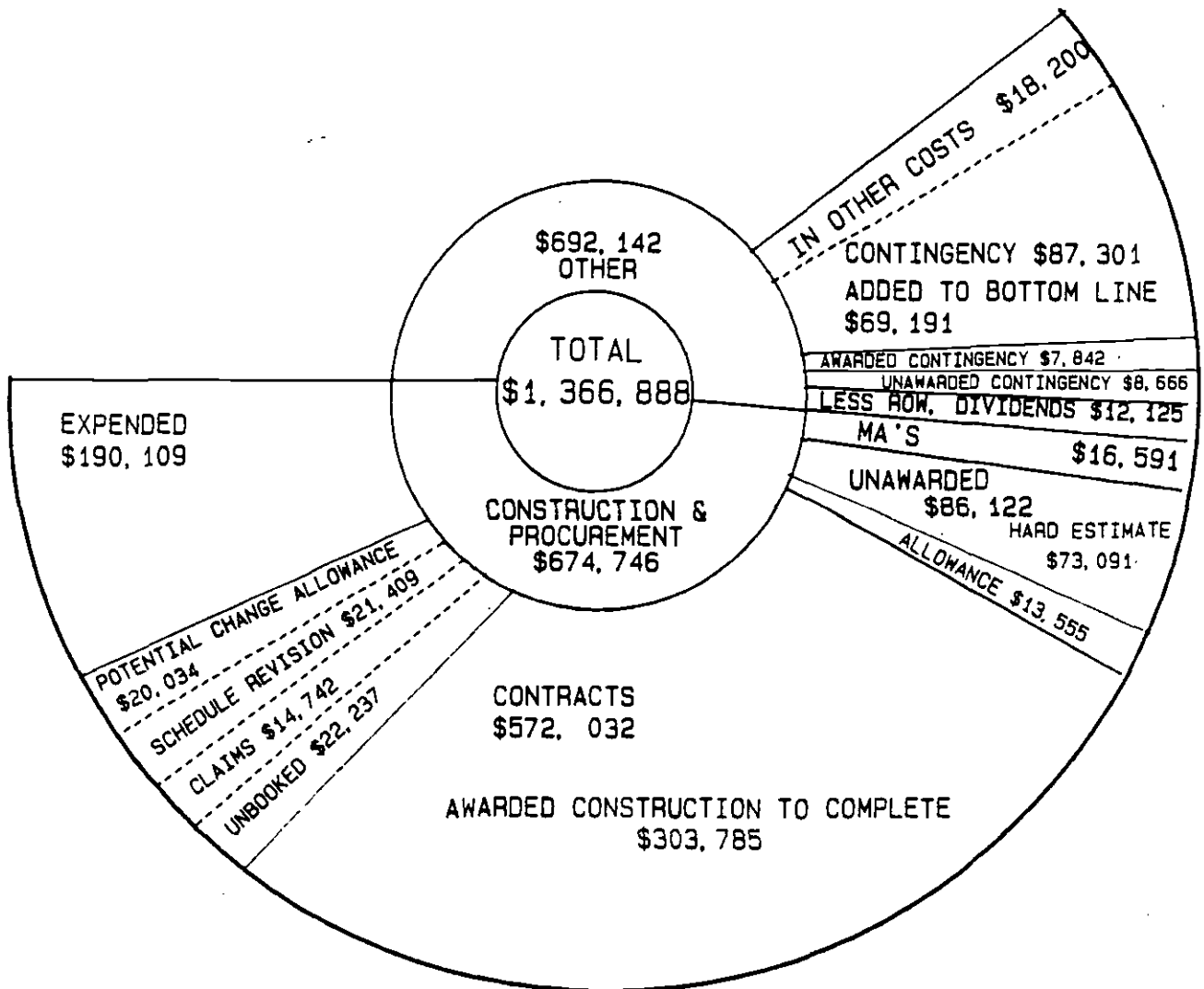


EXHIBIT IV - 13
 MASTER AGREEMENT STATUS
 SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

CONTRACT	CONTRACT DESCRIPTION	ESTIMATE TO COMPLETE AMOUNT	MAY 1989 STATUS REPORT	EXPENDED THROUGH MAY 1989
		VALUE	VALUE	
MA-002	CITY OF LOS ANGELES (87-91)	8,334,000	8,251,000	1,920,000
MA-005	WATER REPLENISHMENT	300,000	300,000	-
MA-007	TELEPHONE RELOCATION	2,970,000	2,300,000	691,000
MA-008	WESTERN UNION REPLACEMENT	120,000	120,000	-
MA-009	POWER RELOCATION	2,444,000	2,464,000	650,000
MA-056	CALTRANS	260,000	260,000	43,000
MA-093	GAS RELOCATION	1,118,000	1,118,000	73,000
MA-094	COUNTY OF LOS ANGELES (87-90)	316,000	435,000	109,000
MA-533	CABLE TV RELOCATION	190,000	190,000	33,000
MA-A09	WATER RELOCATION	2,998,000	2,786,000	1,142,000
MA-545	CHEVRON	-	90,000	-
----- TOTALS		\$19,050,000	\$18,314,000	\$4,661,000
MRT FACTOR		0.871	0.871	0.871
MRT VALUE		16,592,550	15,951,494	4,059,731
DEDUCT EXPENDED		4,059,731		
UNEXPENDED MASTER AGREEMENT		=====		
		\$12,532,819		

EXHIBIT IV-14
 ALLOWANCES ASSOCIATED WITH
 MASTER AGREEMENT
 SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

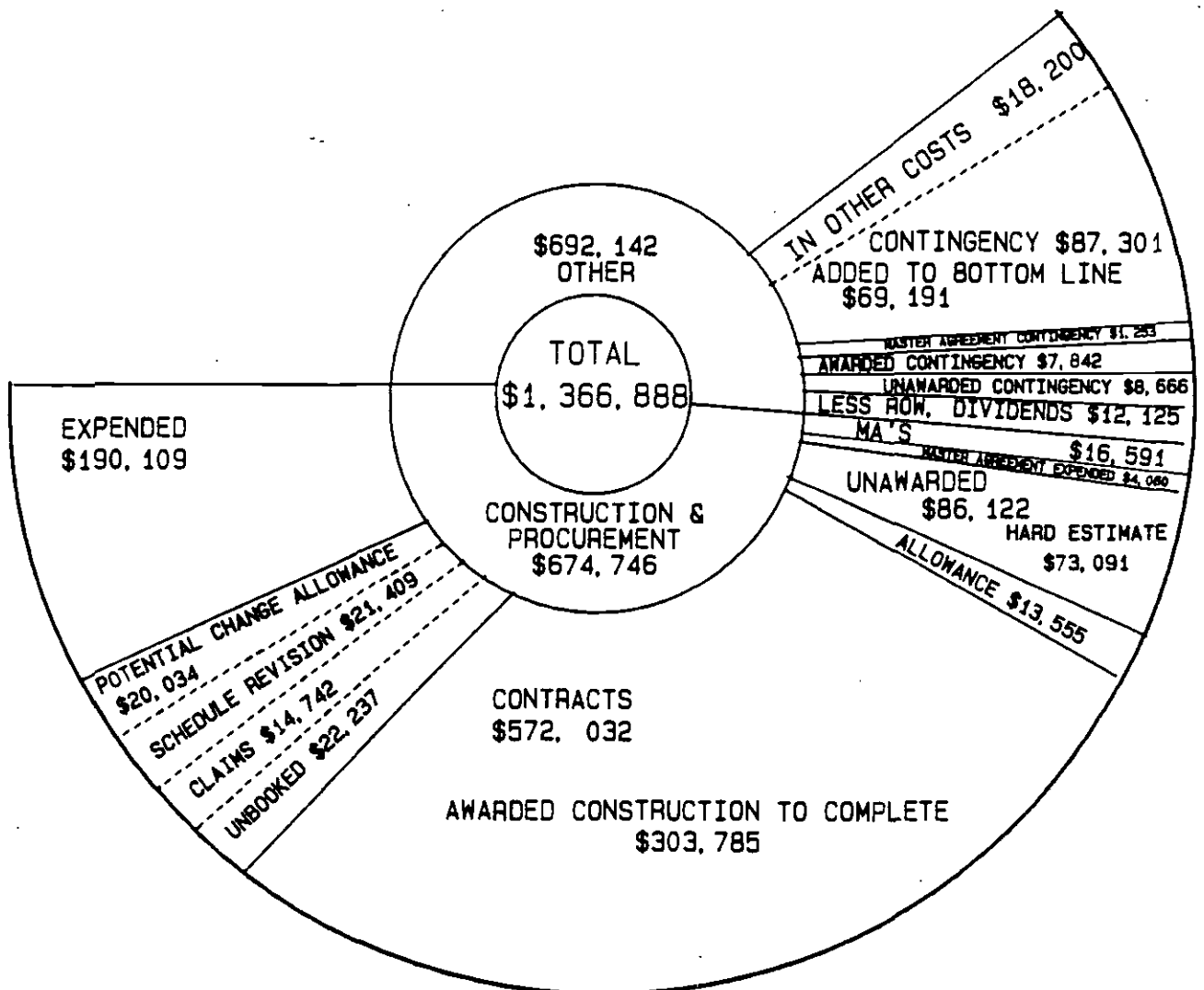


Exhibit IV-15
 Other Costs; Total,
 Expended and to Complete
 Southern California Rapid Transit District

Description =====	Total Estimate To Complete (000) =====	Expended to June 30, 1989 RE: 3/31/89 Schedule and Financial Plan (000) =====	Balance to Complete (000) =====
General Consultant	\$166,893	\$158,859	\$8,034
Construction Manager	\$94,494	\$48,555	\$45,939
Const Related Prof Serv	\$11,814	\$3,974	\$7,840
Des. Related Prof. Serv	\$12,928	\$12,928	\$0
Agency	\$119,974	\$60,505	\$59,469
Right of Way	\$110,305	\$100,000 *	\$10,305
OCIP	\$53,603	\$25,480 **	\$28,123
Preliminary Engineering	\$32,800	\$32,800	\$0
Total before Contingency	----- \$602,811	----- \$443,101	----- \$159,710
Contingency	\$18,200	\$0	\$18,200
	----- \$621,011 =====	----- \$443,101 =====	----- \$177,910 =====

* Representative Estimate

** Through October 1989

Exhibit IV-17
Revision 1, Estimate To Complete
Southern California Rapid Transit District

Total Estimate to Complete:

Administration and Indirect Cost		\$622,951,000
Construction and Procurement		\$674,745,773

Sub-total Cost at Completion		\$1,297,696,773
Less Expended to Date		(\$605,790,000)

To Complete		\$691,906,773
Less Allowances In Cost to Complete:		
Contingency and Escalation, Unawarded	(\$13,555,000)	
Awarded, Potential Changes	(\$20,033,949)	
Awarded, Schedule Revisions	(\$21,409,690)	
Awarded Claims	(\$14,792,366)	
Awarded Unbooked Changes/Claims	(\$22,273,000)	

Total Allowances	(\$92,064,005)	(\$92,064,005)

		\$599,842,768

To Be Expended

Total Cost Before Contingency		\$1,297,696,773
Contingency at 10% of Total Expended		\$59,984,277

Total Funds Required		\$1,357,681,050
Less Deductions:		
Less Row	(\$6,624,943)	
Less Dividend	(\$5,500,000)	

	(\$12,124,943)	(\$12,124,943)

		\$1,345,556,107
Less Original Budget		(\$1,249,900,000)

		\$95,656,107
		=====

EXHIBIT IV - 19-1
 REVISION 3 ESTIMATE TO COMPLETE
 SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

TOTAL CONSTRUCTION AND PROCUREMENTS		674,746,000		
<hr style="border-top: 1px dashed black;"/>				
EXPENDED TO DATE:				
CONTRACTS	190,109,000			
MASTER AGREEMENTS	4,066,000			
	<hr style="border-top: 1px dashed black;"/>			
	\$194,175,000	194,175,000		
ALLOWANCES INCLUDED:				
UNAWARDED CONTRACT CONTINGENCY AND ESCALATION	13,555,000			
POTENTIAL CHANGES - AWARDED CONTRACTS	20,034,000			
SCHEDULE REVISIONS - AWARDED CONTRACTS	21,410,000			
UNBOOKED CLAIMS - AWARDED CONTRACTS	14,792,000			
	22,273,000			
	<hr style="border-top: 1px dashed black;"/>			
	\$92,064,000	92,064,000		
TOTAL EXPENDED AND ALLOWANCES		<hr style="border-top: 1px dashed black;"/>	\$286,239,000	286,239,000
TOTAL TO COMPLETE AWARDED CONTRACTS, UNAWARDED CONTRACTS AND MASTER AGREEMENT			<hr style="border-top: 1px dashed black;"/>	\$388,507,000
AWARDED CONTRACTS TO COMPLETE	303,785,000			
UNAWARDED CONTRACTS HARD ESTIMATE	73,091,000			
MASTER AGREEMENT BALANCE	12,525,000			
	<hr style="border-top: 1px dashed black;"/>			
	\$389,401,000			388,507,000
<hr style="border-top: 1px dashed black;"/>				
TOTAL OTHER COSTS EXCLUDING CONTINGENCY			604,751,000	
<hr style="border-top: 1px dashed black;"/>				
EXPENDED TO DATE:			445,041,000	
TOTAL TO COMPLETE			<hr style="border-top: 1px dashed black;"/>	\$159,710,000
				159,710,000
<hr style="border-top: 1px dashed black;"/>				
TOTAL TO COMPLETE				\$548,217,000

EXHIBIT IV - 19-2
 REVISION 3 ESTIMATE TO COMPLETE
 SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

				CONTINGENCY FACTOR	CONTINGENCY
TOTAL CONSTRUCTION AND PROCUREMENTS			674,746,000		
<hr style="border-top: 1px dashed black;"/>					
EXPENDED TO DATE:					
CONTRACTS	190,109,000				
MASTER AGREEMENTS	4,066,000				
	\$194,175,000	194,175,000			
ALLOWANCES INCLUDED:					
UNAWARDED CONTRACT CONTINGENCY AND ESCALATION	13,555,000				
POTENTIAL CHANGES - AWARDED CONTRACTS	20,034,000				
SCHEDULE REVISIONS - AWARDED CONTRACTS	21,410,000				
UNBOOKED CLAIMS - AWARDED CONTRACTS	14,792,000				
	22,273,000				
	\$92,064,000	92,064,000			
TOTAL EXPENDED AND ALLOWANCES		\$286,239,000	286,239,000		
TOTAL TO COMPLETE AWARDED CONTRACTS:			\$388,507,000	388,507,000	
UNAWARDED CONTRACTS AND MASTER AGREEMENT				10 %	30,378,500
AWARDED CONTRACTS TO COMPLETE	303,785,000			10 %	7,309,100
UNAWARDED CONTRACTS HARD ESTIMATE	73,091,000			0 %	0
MASTER AGREEMENT BALANCE	12,525,000				
	\$389,401,000				
<hr style="border-top: 1px dashed black;"/>					
TOTAL OTHER COSTS EXCLUDING CONTINGENCY			604,751,000		
<hr style="border-top: 1px dashed black;"/>					
EXPENDED TO DATE:			445,041,000		
TOTAL TO COMPLETE			\$159,710,000	159,710,000	5 % 7,985,500
<hr style="border-top: 1px dashed black;"/>					
TOTAL TO COMPLETE			\$548,217,000		\$45,673,100

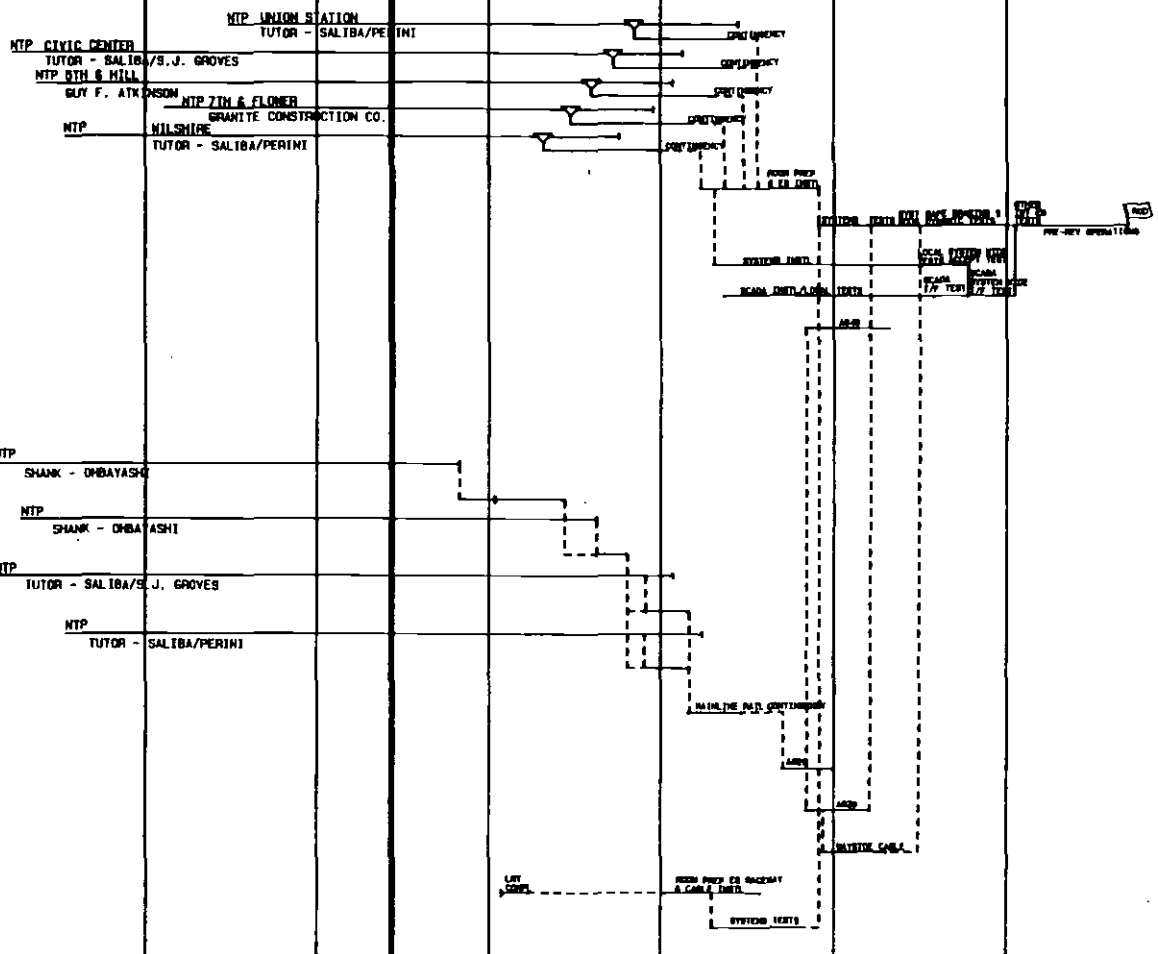
Exhibit IV 19-3
Revision 3 Estimate to Complete
Southern California Rapid Transit District

Total Estimate to Complete:		
Administration and Indirect Costs (Excluding Contingency)		\$604,751,000
Construction and Procurement Costs		\$674,745,773
Total		----- \$1,279,496,773
Contingency from Contingent Anlysis		\$45,673,100
		----- \$1,325,169,873
Less Deductions:		
Less Row	(\$6,624,943)	
Less Dividend	(\$5,500,000)	
	----- (\$12,124,943)	
Less Original Budget		\$1,313,044,930
		----- (\$1,249,900,000)
Overrun		----- \$63,144,930 =====

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

EXHIBIT V-1
PROBABLE SCHEDULE, REVISION 7, WITH ACTUALS

ITEM	1987	1988	1989	1990	1991	1992	1993
STATION STAGE 1, ACCESS STAGE 2							
A130 W/S STAGE 1							
A130 W/S STAGE 2							
A140 C/C STAGE 1							
A140 C/C STAGE 2							
A140 S/A STAGE 1							
A157 S/A STAGE 2							
A166 7/A STAGE 1							
A167 7/A STAGE 2							
A175 W/A STAGE 1							
A177 W/A STAGE 2							
NEW STATION WORK GENERAL BUILDING STRUCT. CO.							
NEW STATION WORK BECHTEL CIVIL INC.							
NEW TUNNEL WORK BECHTEL CIVIL INC.							
NEW TRACK WORK CALIFORNIA ENGINEERING CONTRACTORS							
ACCESS FROM STATIONS TO TRACK							
A171 TUNNEL							
A171 TUNNEL TRACKWORK S106 TO S175							
A146 TUNNEL							
A146 TUNNEL TRACKWORK S116 - A140							
A141 TUNNEL							
A141 TUNNEL TRACKWORK S116 - S141 - S129							
A139 TUNNEL							
A139 TUNNEL TRACKWORK S116 TO TRACK							
WALDLE HILL							
NEW CABLE/TURBINE DIST. GENERAL BUILDING CONTRACTORS CO.							
NEW TUNNEL WORK GENERAL BUILDING CONTRACTORS CO.							
NEW TUNNEL WORK							
NEW STATION WORK							
NEW TARD WORK							



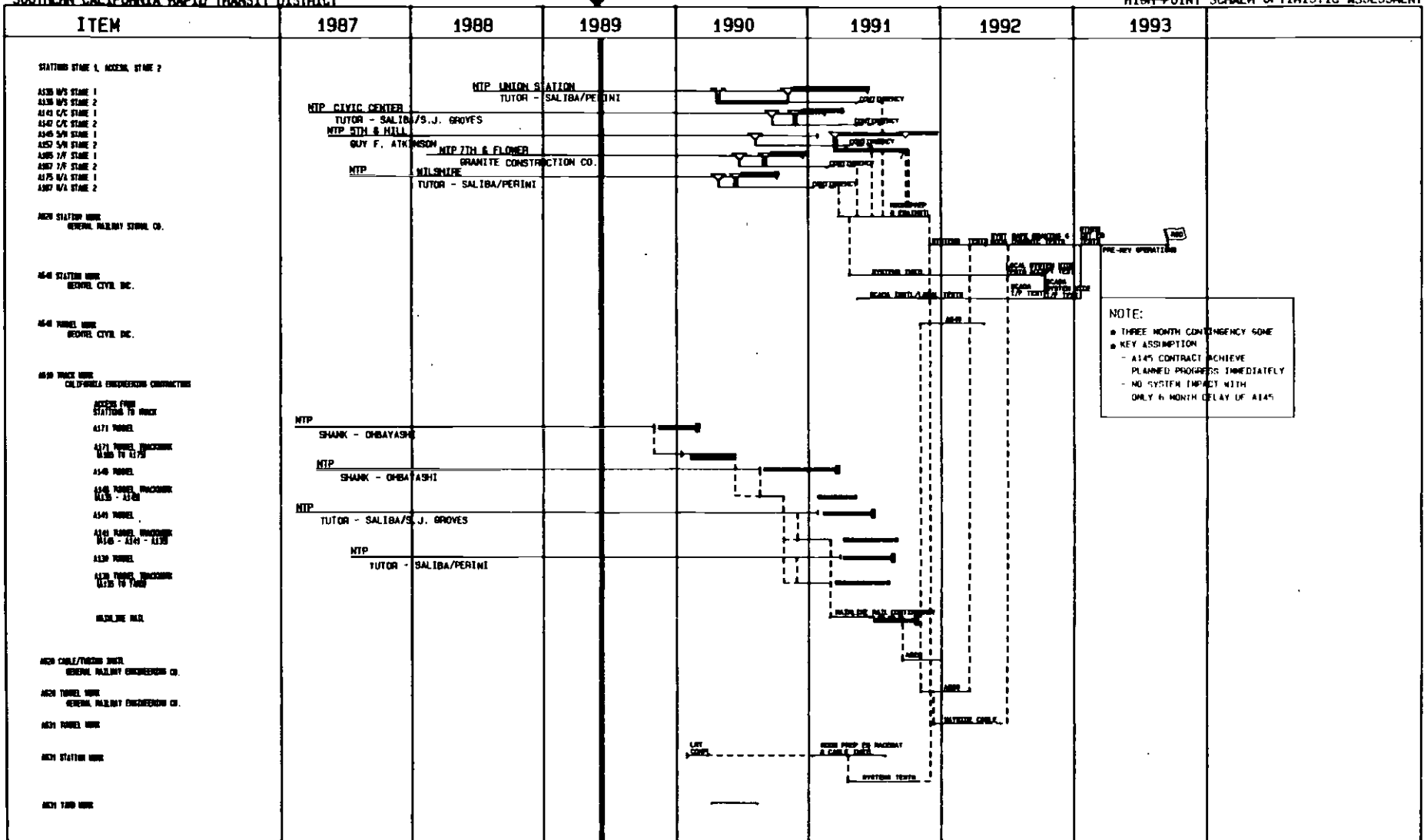


Exhibit V-4
Revision 4 Estimate to Complete
Southern California Rapid Transit District

	PDCD *	SCRTD *	REASSESSED ESTIMATE
Admin, & Indirect	\$622,951,000	\$622,951,000 **	\$631,365,000
Direct Costs	\$650,266,328	\$674,745,773	\$664,105,063
Subtotal Cost to Complete	\$1,273,217,328	\$1,297,696,773	\$1,295,470,063
Sub-total Cost to Complete	\$1,273,217,328	\$1,297,696,773	\$1,295,470,063
Less - Expend. to Date	(\$605,790,000)	(\$605,790,000)	(\$605,790,000)
Expend. Remaining	\$667,427,328	\$691,906,773	\$689,680,063
Sub-total Cost to Complete	\$1,273,217,328	\$1,297,696,773	\$1,295,470,063
Add 10% Contingency	\$66,742,733	\$69,190,677	\$68,968,006
Total Forecast to Complete	\$1,339,960,061	\$1,366,887,450	\$1,364,438,069
Less Original Budget	(\$1,249,900,000)	(\$1,249,900,000)	(\$1,249,900,000)
Overrun	\$90,060,061	\$116,987,450	\$114,538,069
Less Row	(\$6,624,943)	(\$6,624,943)	(\$6,624,943)
Less Dividend	(\$5,500,000)	(\$5,500,000)	(\$5,500,000)
Adjusted Overrun	\$77,935,118	\$104,862,507	\$102,413,126

Less Included
Contingency
\$13,473,419 Within Unawarded
\$1,347,342 10% Taken on Value

NOTE:

* Source: MRT Program Control, June 23, 1989

(\$14,820,761)

\$14,820,761

** Both PDCD and SCRTD include \$18,200,000 as Contingency which is removed from HPS value

\$87,592,365

*** Includes \$13,473,419 of In Line Allowances in Schedule Reserves Contingency and Escalation in Unawarded Contracts

**** Claims are Included at Full Claimed Amount

Exhibit V-5-1
Revision 5 Estimate to Complete
Southern California Rapid Transit District

TOTAL TO
GO

TOTAL CONSTRUCTION AND PROCUREMENT	\$664,105,063	
<hr style="border-top: 1px dashed black;"/>		
EXPENDED TO DATE		
CONTRACTS	\$204,528,000	
MASTER AGREEMENTS	\$4,661,000	
	<hr style="border-top: 1px dashed black;"/>	
	\$209,189,000	\$209,189,000
ALLOWANCES INCLUDED:		
UNAWARDED CONTRACT CONTINGENCY AND ESCALATION	\$13,473,419	
POTENTIAL CHANGES - AWARDED CONTRACTS		
SCHEDULE REVISIONS - AWARDED CONTRACTS	\$24,766,097	
UNBOOKED CLAIMS - AWARDED CONTRACTS	\$22,595,489	
	<hr style="border-top: 1px dashed black;"/>	
	\$60,835,005	<hr style="border-top: 1px dashed black;"/>
	\$60,835,005	
 TOTAL EXPENDED AND ALLOWANCES	 \$270,024,005	 \$270,024,005
TOTAL TO COMPLETE AWARDED CONTRACTS:		
UNAWARDED CONTRACTS AND MASTER AGREEMENT		\$394,081,058
AWARDED CONTRACTS TO COMPLETE (TOTAL)	\$314,973,184	
UNAWARDED CONTRACTS HARD ESTIMATE	\$69,298,702	85% \$15,748,659
MASTER AGREEMENT BALANCE	\$14,453,000	@10% \$6,929,870
	<hr style="border-top: 1px dashed black;"/>	@0% \$0
	\$398,724,886	
	ROUNDING DATABASE	
	DIFFERENCES	
<hr style="border-top: 1px dotted black;"/>		
TOTAL OTHER COSTS EXCLUDING CONTINGENCY	\$631,365,000	
<hr style="border-top: 1px dashed black;"/>		
EXPENDED TO DATE:		
TOTAL TO COMPLETE	\$445,042,000	
	<hr style="border-top: 1px dashed black;"/>	
	\$186,323,000	\$186,323,000
		@2% \$3,726,460
		<hr style="border-top: 1px dashed black;"/>
		\$580,404,058
 TOTAL TO COMPLETE		 \$26,404,989
		<hr style="border-top: 1px dashed black;"/>